Pit and Quarry

Vol. 15 CHICAGO, ILL., MARCH 28, 1928 No. 13

WHAT ABOUT THE INCREASING HIGHWAY ACCIDENTS

By Charles M. Upham

DURING every twenty-four hours of 1927 an estimated average of 2,261 persons were killed or injured in highway accidents—one every 39 seconds! The estimated economic loss resulting from these accidents was $672,097,000 not including insurance premiums—nearly two million dollars every day of the year.

The 1927 casualties, according to the American Road Builders' Association, showed an increase of 1,316 deaths over 1926. The total fatalities for 1927 was placed at 26,618, and the number of serious injuries at 798,700. Minor accidents involving property damage only, were not taken into consideration in the statistical report released by the association, although these accidents have been estimated to occur at the rate of 25,000 daily.

What do these figures show? Do they mean that the American people are becoming inherently reckless at the wheel of an automobile? Do they mean that modern cars are too fast or too inefficient to be safely operated on our present system of streets and highways and under the present traffic regulations?

A careful analysis of these figures will show that no one thing may be stated as the cause of highway accidents. Such an analysis, however, will show the following facts:

1. That the human factor is responsible for 95 per cent of all accidents and the mechanical factor responsible for the remaining negligible portion.

2. That the human factor which causes highway accidents is in a large degree caused by certain definable physical conditions such as complex traffic laws, traffic congestion, discourtesy on the part of other motorists, carelessness on the part of other motorists, physical incompetency, lack of confidence in the mechanical dependability of a motor vehicle and the improper conduct of pedestrians.

3. That approximately 60 per cent of all fatalities are pedestrians.

4. That more than 7,300 of the fatalities in 1927 were children of school age, and that nearly twice as many persons are killed between the ages of 6 and 12 than during any other similar group of years between 1 and 70.

5. That although highway accidents increased considerably during 1927, that increase was not out of proportion to the increased registration of motor vehicles and the growth in population.

6. That accidents involving pedestrians continue to grow in number faster than accidents involving two vehicles or collisions with immobile objects.

A great mass of data has been collected by organizations interested in highway safety. Study of this material has resulted in many and varied conclusions as to the best method for reducing accidents. The American Road Builders' Association last year made such a study, and concluded that the individual alone could be held responsible for curbing the fast growing number of fatal and non-fatal highway accidents. A campaign for Courtesy and Caution was launched and the slogan found its way into thousands of schools, churches, civic and industrial organizations and private homes of the United States.

The Courtesy and Caution method for reducing highway accidents is marked with simplicity. A study of the statistical information available has led to the following objectives to be used in the conduct of such a campaign for national highway safety:

1. The education of pedestrian traffic in the principles of simple courtesy and caution while on the public street. The use of common sense is recommended in lieu of the cut and dried adherence to a complex list of safety rules.

2. The thorough examination and licensing of all drivers of motor vehicles.

3. The adoption of a uniform simple code of traffic laws, both state and municipal.

4. The education of drivers in the principles of simple courtesy and caution.

No accurate detailed information as to the cause of accidents and the number occuring is available. The figures given in this article, however, are approximate and are drawn from all accessible information. The following synopsis of the relative importance of accident causes is given to emphasize the paramount necessity for the practice of Courtesy and Caution under varying conditions.

It is estimated that 11,765 persons were killed during 1927 in accidents caused principally by motorists. Fatalities caused principally by pedestrians is placed at 11,367, and those resulting from accidents caused principally by physical conditions at 3,486. In estimating for tabulation the various causes for these accidents, the American Road Builders' Association has used a progress report

issued by the National Automobile Chamber of Commerce for 100 cities in 1926. The table follows:

FATALITIES CAUSED PRINCIPALLY BY MOTORISTS

Total killed in 1927		11,765
Inattention	32%	3,765
Speeding	23%	2,706
Traffic violation	20%	2,353
Intoxication	9%	1,059
Miscellaneous	16%	1,882

FATALITIES CAUSED PRINCIPALLY BY PEDESTRIANS

Total killed in 1927		11,367
Children playing in the street or crossing in violation of traffic regulation	32%	3,638
Adult jay-walking	27%	3,069
Inattention	16%	1,819
Confusion	14%	1,591
Other causes	11%	1,250

FATALITIES CAUSED PRINCIPALLY BY PHYSICAL CONDITIONS

Total killed during 1927		3,486
Fog, snow or rain	37%	1,290
Defect in vehicle	19%	662
Skidding	16%	558
Road defect	11%	383
Strong lights	7%	244
Poor street light	7%	244
Confusion in dimming	3%	105

From the foregoing table it may readily be seen that most highway accidents are from causes which cannot be regulated by any number of traffic regulations. The three principal causes—inattention, children playing in or crossing the streets, and adult jay-walking took 12,291 lives, or nearly 52 per cent of the total 23,496 fatalities for which causes were listed. No amount of enforceable traffic law will reach these causes.

What then, is the solution? It is impossible to eliminate highway accidents. With 23,000,000 vehicles using the streets and highways of a country peopled with 110,000,000 human beings, there will always be fatalities, both avoidable and unavoidable. It is not unreasonable to believe, however, that the present toll is much too high, and that by concentrated effort on the part of organizations interested in the problem, it may be considerably reduced.

THE TREND IN "VACATIONS-WITH-PAY"

WHILE March is a period considerably in advance of the regulation vacation months, it is none too early for executives of companies not now allowing vacations-with-pay to their industrial workers to give consideration of the problem. If in no other way that statement is substantiated by the fact that more than 500,000 shop and factory works in the United States are now effected by vacation plans now in force. More and more are industrial workers being accorded vacation privileges similar to those in clerical or sedentary activity. The tendency in American industry to shorten the working period is finding expression in the more universal adoption of some form of vacation plan.

Naturally enough the employer considering the adoption of a vacation plan wants to know in advance, so far as possible, what effect that plan will have upon his business. In this regard it may be said that there is abundant evidence from the experience of other firms that labor turnover, absenteeism and production are favorably affected by this seemingly altruistic action. As an example, one firm granted a week's vacation to every worker who had less than ten days' unexcused absence in the preceding year. In four years of operation, this policy lifted the percentage of employees qualified for vacations from 42 to 98—a record that speaks volumes for the reduction of absenteeism.

In the majority of cases vacation plans should be based on some definite term of service, such as one year, two years, or more. Such establishment will invariably lessen turnover if the length of vacation granted is sufficient to warrant effort on the part of the worker. The most common period allowed is one week after one year's service, while in many cases this vacation period is lengthened to ten days or two weeks, according to periods of continuous service—from two to ten years. More than half of the vacation plans now in force are graduated in some such manner.

It is interesting to know that plant managers and superintendents of companies practicing vacation plans are almost unanimous in the belief that vacations have a directly beneficial effect on production. Indeed this factor was the underlying motive in the adoption of new plans or the liberalizing of old plans in several instances.

Some vacation advocates are wont to assume that nothing but good for the worker can come from having time off with pay. This is fallacious. Vacations, by anyone, must be properly employed if they are not to defeat their intended purpose. The ideal and profitable vacation involves a change of scene and occupation, an opportunity for outdoor exercise, and in the case of married men should permit the whole family to share in it. The unassisted efforts of many individuals, particularly if he is of foreign extraction, can seldom achieve the ideal vacation. It is here that companies, either through their own efforts or through the assistance of an outside agency, may do much to not only aid the worker in getting to expected rest but to insure for themselves the beneficial results that should be forthcoming.

MEN OF THE INDUSTRY

The portraits printed on this page in each number of PIT and QUARRY are taken from our files and their selection is without significance as to current events or as to the position of the individual in the industry.

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DISCUSSING THE BUREAU OF PUBLIC ROADS REPORT OF NEW JERSEY COMPARATIVE TESTS ON CRUSHED STONE AND GRAVEL CONCRETE

By Stanton Walker
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THE comparative tests of crushed-stone and gravel concrete carried out through the co-operation of the U. S. Bureau of Public Roads and the New Jersey State Highway Commission, furnish much information which merits careful study. The report prepared by Mr. Jackson is an accurate and concise statement of the results of the tests and his discussion has been written with great care to avoid the possibility of the data being misinterpreted or of being applied generally as a criterion of the concrete making properties of crushed stone and gravel.

It is our belief, however, that the investigation is incomplete in some respects, that certain of the conclusions drawn by the author are not fully justified by the test data and that a further discussion of certain features of the investigation will be helpful. Our discussion will deal principally with Series A, since it is that part of the investigation which is most applicable to existing conditions, and since the results of the two series are very much the same so far as comparisons of the two aggregates are concerned. The discussion is also confined, for the most part, to the flexure tests, as it is only these that furnish information at variance with generally accepted facts. The fact that gravel concrete gives compressive strengths the equal of crushed stone concrete in similar proportions, even though 6 to 8 percent less cement may be used, is well recognized and is supported by these tests. Within a wide range of quality the type and characteristics of aggregates have been found to have little effect on the compressive strength.

Only Two Aggregates Tested

A general criticism which may be offered of the entire investigation is that consideration is given to only one aggregate of each type. Mr. Jackson recognizes this deficiency in the investigation and points out that the results should be considered as "applicable only to the same kinds of material, produced in a similar manner." He also points out that other tests which the Bureau now has under way, and which we understand will be available by the latter part of this summer, indicate that the characteristics of the particular aggregate used may be fully as important as the type of material to which it belongs.

It would have been helpful if the present report had included the results of such tests. Their inclusion would present information concerning the relative merits of crushed stone and of gravel which could be applied more generally and would eliminate the possibility of too broad conclusions being drawn from these data. The fact that the crushed stone used in the tests was a very hard, tough and dense rock is an added reason for making desirable the consideration of tests of other materials. The gravel used was a good grade of material with physical characteristics well within the usual specification limits, but possessing no exceptional features.

Other Investigations

The statement that these tests should not be construed as a criterion of the relative concrete making properties of crushed stone and gravel in general, so far as transverse strength is concerned, is well supported by results of tests from other investigators. Tests carried out by Abrams at the Structural Materials Research Laboratory and reported in his Bulletin 11 on "Flexural Strength of Plain Concrete," show that the gravel tested (from the Chicago Gravel Company) gave results at least as high as were obtained from a good quality crushed limestone, crushed granite and crushed blast furnace slag. The results of these tests are given in Table A.

TABLE A.—Effect of Kind of Aggregate on Flexural Strength of Concrete

(Data from Table VII, Bulletin 11, Structural Materials Research Laboratory)

Mix: 1:4 by volume.

Relative consistency, 1.10; water-ratio, 0.82.

Aggregate: Sand, 0-No. 4; and coarse aggregate, No. 4 to 1½ in.; all of same grading.

Specimens tested damp.

Each value is the average of 5 tests made on different days.

Ref. No.	Kind of aggregate: Sand	Kind of aggregate: Coarse	Modulus of rupture of beams, lb. per sq. in.: 7 d.	28 d.	3 m.	1 y.
7, 8	Janesville	Elgin Pebbles	420	550[1]	810	880
54	Janesville	Slag	450	585	765	760
55	Janesville	Limestone	440	595	790	830
56	Janesville	Granite	375	540	665	725

[1] Average of 25 beams.

Table B summarizes the results of transverse tests of gravel and crushed stone concrete carried out by the Bureau of Public Roads and reported in the paper on "Accelerated Wear Tests of Concrete," by Jackson and Pauls.

TABLE B.—Transverse Strength of Crushed Stone and Gravel Concrete at 90 Days

Data from Jackson and Pauls' Paper on "Accelerated Wear Tests of Concrete"; Public Roads, May, 1924.

Section No.	Source	Type	Size	Modulus of rupture of beams lb. per sq in.
		Gravel		
11	Potomac River	Siliceous	¼-1 in.	527
12	Will Co., Ill.	Dolomite	¼-1½ in.	659
13	Warren Co., Ind.	Glacial [1]	¼-1½ in.	517
14	St. Joseph Co., Ind.	Glacial [1]	¼-1½ in.	538
15	Marathon Co., Wis.	Silicious	¼-1½ in.	536
16	Hampden Co., Mass.	Siliceous	¼-1½ in.	532
17	Richland Co., S. C.	Siliceous	¼-1½ in.	544
18	Vanderburg Co., Ind.	Siliceous	¼-1 in.	524
10	Hancock Co., Ia.	Glacial [1]	¼-1½ in.	529
	Average			545
		Crushed Stone		
1	Berkeley Co., W. Va.	Dolomite	¼-1½ in.	480
2	Somerset Co., N. J.	Diabase	¼-1½ in.	512
3	Minnehaha Co., S. D.	Quartize	¼-1½ in.	677
4	Llano Co., Texas	Granite	¼-1½ in.	607
5	Texas	Slate	¼-1½ in.	483
6	Pine Co., Minn.	Sandstone	¼-1½ in.	632
7	Wise Co., Va.	Sandstone	¼-1½ in.	499
8	Huron Co., Ohio	Limestone	¼-1½ in.	692
9	Presque Isle Co., Mich.	Limestone	¼-1½ in.	509
10	Jones Co., Ia.	Dolomite	¼-1½ in.	509
	Average			569

[1] Mixtures of several rock types.

Transverse strengths were determined in this latter investigation for concrete made with ten crushed stones and nine gravels, as well as for certain other materials. The average of all the stones tested gave a modulus of rupture (transverse strength) of 569 lb. per sq. in. at three months, as compared with 545 lb. per sq. in. for the gravel. Among the crushed stones is one from Somerset, New Jersey (Section 2), which appears to have similar physical characteristics to the crushed trap used in the New Jersey tests; it is interesting to note that the result of the transverse strength tests of this aggregate is lower than that obtained from any of the nine gravels tested.

In connection with the tests reported by Jackson and Pauls, it should be pointed out that there seems to be an excellent possibility that, in general, the gradings of the gravel aggregates were somewhat finer than those of the crushed stone aggregates, due to the fact that the materials were tested graded as received. This is also confirmed by the sizes of materials listed in Table B. The use of the finer gradings ordinarily would be supposed to produce a lower strength.

Aggregate Gradings Tested Do Not Conform to Specification Limits

A second general criticism which may be made of the investigation is that, while it was designed as a study of conditions applicable to New Jersey, only two of the thirteen gradings of crushed stone and four of the gravel fall within the limits of the current specifications. *In other words, 77 per cent of the tests were made with aggregates which would not be permitted in paving construction in New Jersey because of their grading.*

The specifications for grading of aggregates for use in pavement construction in New Jersey are given in Table C.

TABLE C.—New Jersey State Highway Commission Specifications for Coarse Aggregate for Concrete Pavement Construction

From "Requirements Governing Road Materials" of the New Jersey Highway Department issued in 1926.

Type	Total per cent passing 2¼"	1½"	1¼"	⅝"	½"	¼"
Concrete Stone	100	...	40-70	0-15	0-10	0-5
Concrete Gravel	100	...	40-70	....	0-12	0-2
¾ in. Gravel	...	100	75-100	....	0-25	0-5

A comparison of these specifications with the sieve analyses of the coarse aggregates given in Table 1 of the report will show that only Gradings 8 and 12 may be considered as falling within the limits of the requirements for "concrete" stone or gravel, and that there is some question as to whether these would pass. Gradings 11 and 13 would be considered as meeting the requirements for "¾ in. gravel," although Grading 13 is barely within the limits.

Figure A provides a convenient method of showing clearly the relation of each of the gradings tested to existing specifications of the State of New Jersey. The aggregate gradings have been arbitrarily divided into the following three sizes:

1. Material above 1¼ in.
2. Material passing 1¼ in. and retained on ½ in.
3. Material passing ½ in.

These divisions were selected since they seem to represent the more important size limitations in the specifications. The percentage passing the 1¼ in. screen for the aggregates used in the tests were determined by straight-line interpolation. Area "A" represents the approximate limits of the New Jersey Specification for concrete stone, "B" for concrete gravel, and "C" for ¾ in. gravel. While the diagram does not show all of the details of the specification it confirms the study of the sieve analyses. All gradings, except 8, 11, 12 and 13, fall outside the New Jersey specification limits in force at that time, and these, with the possible exception of 11 in the case of gravel, probably do not represent typical gradings such as are generally used.

It would seem highly desirable in a study of existing conditions to include at least some gradings typical of those commonly used in practice. None of the gradings tested, with the possible exception of No. 11 in the case of gravel, meet that condition.

Variations Due to Grading Greater Than to Type of Aggregate

All of the comparisons of the two aggregates in

the report are based on the averages of the thirteen gradings and no importance is attached to the effect of grading, in spite of the fact that the differences in strength due to this factor were two or three times greater than those attributed to the type of aggregate. Consequently the comparisons are based entirely on the same gradings, while, under the existing conditions of which the investigation was intended as a study, the gravel and trap-rock as furnished to the job in accordance with specifications would not ordinarily be similarly graded.

While thirteen gradings and only two aggregates were tested, no recommendations are made for taking advantage of better graded materials for the reason that a definite relationship was not found; in fact, it is stated that the grading of the coarse aggregate had very little direct effect upon the strength of the concrete. In accordance with the conclusion that the stone produced about 12 per cent higher transverse strength, it is recommended in the report that, for equivalent slab strengths, the gravel concrete should be made with a thickness of about 6 per cent greater than the stone concrete. On the basis of these tests and by a similar process of reasoning, variations in pavement thickness of as much as 16 per cent might logically be required, due to the differences in grading. It seems hardly logical to eliminate differences of two and three times 12 per cent from all consideration and at the same time to make definite recommendations with respect to another variable based on the much smaller difference.

The fact that the strengths do not seem to follow any well-known measure of grading of aggregate should not be sufficient to eliminate this factor from all consideration, especially when certain other tests have indicated definitely that grading is an important factor. On the other hand, if this failure to obtain expected results with reference to grading makes it seem desirable to give no consideration to this aspect of the tests, it would appear inconsistent to give credence to the tests in other respects.

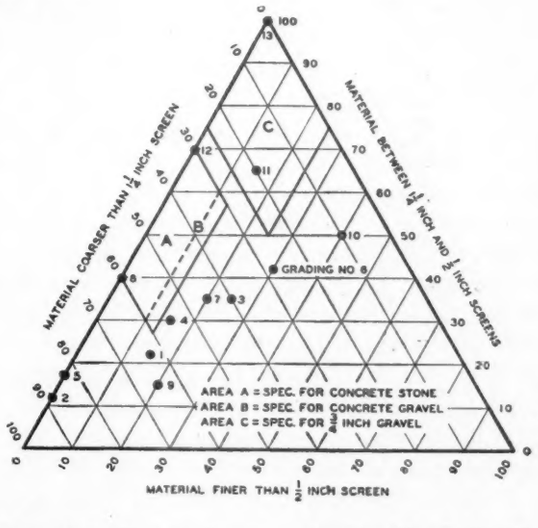
A study of the data in the report would indicate that differences in strength obtained with the different gradings were brought about by a variable which affected both the gravel and the stone alike, since the curves for the two aggregates closely follow each other. If the comparison is made on the basis of the averages of the 28-day and 6-month tests, this view is supported. If these variations are due to differences in grading, these tests, as well as others, would indicate that a consideration of the grading is of even greater importance than that of the type of aggregate.

Comparisons of Typical Gradings Desirable

If a thorough investigation of different types of aggregates is to be made it should involve comparisons of gradings of each material which are actually used in practice—together with a careful study of the effect of grading. In other words, what is the comparison in strength and economy of concrete made from gravel of a typical grading with that of crushed stone of a typical grading? The gradings used in these tests preclude the possibility of making a satisfactory study on this basis.

TABLE D.—Comparison of Crushed Stone and Gravel Based on Typical Grading
Data from Tables 5 and 13 of Mr. Jackson's Report.

Grading No.	Assumed as typical of	Cement sacks per cu. yd. of concrete	Modulus of rupture of beams lb. per sq. in 28 d.	6 in.	Av.
8	Crushed Trap	6.5	515	715	615
12	Crushed Trap	6.6	515	680	618
	Average	6.6	515	698	616
11	Gravel	5.9	525	600	562
13	Gravel	6.1	550	605	578
	Average	6.0	538	602	570


MATERIAL COARSER THAN 1¼ INCH SCREEN
MATERIAL BETWEEN ¼ INCH AND ½ INCH SCREENS
MATERIAL FINER THAN ¼ INCH SCREEN
GRADING NO 8
AREA A = SPEC. FOR CONCRETE STONE
AREA B = SPEC. FOR CONCRETE GRAVEL
AREA C = SPEC. FOR ¾ INCH GRAVEL
MATERIAL FINER THAN ½ INCH SCREEN

As pointed out above, only Gradings 8, 11, 12 and 13 meet the requirements of the specifications. Gradings 8 and 12 are near the coarser limits of the grading requirements for "concrete" stone and gravel. Gradings 11 and 13 are within the limits set for ¾ in. gravel. If the first two gradings (8 and 12) are considered typical of crushed stone and the last two (11 and 13) typical of gravel, the comparison shown in Table D may be made.

From this comparison it will be seen that about 10 per cent more cement was required for Gradings 8 and 12 than for 11 and 13, that the 28-day strengths were approximately the same and that the 6-month strengths for the trap-rock were higher than for the gravel. With reference to the 6 months' tests it should be pointed out that they are abnormally high as compared with 28 days in the case of the trap-rock and abnormally low in the case of the gravel. The average increase in strength from 28 days to 6 months for Series A was 19 per cent for both stone and gravel; in this case the trap-rock concrete increased 31 per cent

and the gravel concrete only 12 per cent, obviously due to irregularities in the tests.

No especial significance is attached to this comparison, except as further evidence of the importance of taking into account the effect of grading.

Certain of the gravel gradings gave higher strengths than certain of the stone gradings and it will be appreciated that if the gravel gradings which gave the higher strengths were compared with the stone gradings which gave the lower strengths, it would be necessary to modify the conclusions with respect to the comparative flexural strengths of the two materials. We are not,

TABLE E.—Average Results from Series A

Aggregate	Cement sacks per cu. yd. of concrete	Modulus of rupture of beams lb. per sq. in.		
		28 d.	6 in.	Av.
Crushed Trap	6.4	570	680	625
Gravel	6.0	505	600	552
Ratio Trap to Gravel ..	1.065	1.13	1.13	1.13

of course, suggesting that this is the proper basis of comparison, but we do suggest that differences in grading should be given consideration, and that the data should answer the question of what is the comparison of economy and concrete making properties of typical gradings of gravel and of crushed stone.

For example, in Series A, the average of all gradings show the values given in Table E.

In the case of both stone and gravel these averages include values for gradings which would not ordinarily be met with in practice; the average for the gravel is affected by strengths obtained with gradings which would practically never occur in practice for gravel and the average for the stone is affected in a similar manner.

In Table F the thirteen different gradings of aggregates have been divided into three classifications, as follows:

1. Aggregate containing none of the smaller sizes, and which may be considered to be more nearly representative of stone than of gravel. Gradings numbers 2, 5, 8 and 12 have been included in this classification.

2. Aggregate containing a medium quantity of the finer sizes and which might conceivably be produced in either stone or gravel. Gradings numbers 1, 4, 7, 9 and 13 have been included in this classification.

3. Aggregate containing a preponderance of the finer material and which may be considered to be more nearly representative of gravel than of stone. Gradings numbers 3, 6, 10, and 11 have been included in this classification.

If we compare the average values for a combination of classifications 1 and 2 as representative of stone gradings, with average values of 2 and 3 considered as representative of gravel, we arrive at the results shown in Table F.

TABLE F.—Comparisons of Yield and Transverse Strength

Data from Series A; weighted averages

Aggregates	Average of grading classifications	Cement, sacks per cu. yd. of concrete	Modulus or rupture of beams lb. per sq. in.		
			28 d.	6 m.	Av.
Trap	1 and 2	6.42	555	680	615
Gravel	2 and 3	5.85	513	608	556
Ratio Trap to Gravel		1.10	1.08	1.12	1.10

From this comparison it will be noted that the differential in strength is more nearly comparable to the differential in cement used. An even more favorable comparison for gravel is found by comparing classifications 1 and 3 (See Table G).

TABLE G.—Comparisons of Yield and Transverse Strength

Data from Series A

Aggregates	Average of gradings Nos.	Cement sacks cu. yd. of concrete	Modulus of rupture of beams lb. per sq. in.		
			28 d.	6 m.	Av.
Stone	2, 5, 8, 12	6.6	544	671	608
Gravel	3, 6, 10, 11	5.8	506	595	550
Ratio Stone to Gravel		1.14	1.08	1.13	1.11

Data on Effect of Proportions Not Complete

A more complete investigation than this would have provided information from which it could be determined what changes in cement content, proportions and gradings of aggregate, etc., would be necessary to place the two aggregates studied on an equal basis. The method of compensation by increasing the thickness of the slab is only one of several which might be applied. Proper changes in grading, proportioning or cement content would serve the same purpose, and the relative economy of these methods should be investigated.

It is interesting to note, however, that the cost of materials required to provide the additional slab thickness of 6.1 per cent, recommended in the report, is approximately the same as the cost of the additional cement required by the crushed stone. The economic advantages of gravel are discussed in detail by Mr. Jackson under the heading of "Yield of Concrete Discussed." When the advantages of gravel due to yield are eliminated, the cutstanding advantages due to workability, ease of handling, etc., still exist and are recognized in the report.

Other Factors Than Strength

The Bureau's report clearly points out the advantages which are generally recognized as inherent to gravel as an aggregate for concrete when compressive strength and economy are the major factors considered. In Table 6 of the report the average of 28-day and 6-month compressive strengths for all gradings of gravel are the same as the average for all gradings of stone in spite of the fact that 6 to 7 per cent less cement was used in the gravel concrete.

The report discusses, and can be expected to discuss, only comparisons based on strength and yield. We would call attention to the fact, however, that in a complete study of the economic advantages of different aggregates, such factors as surface wear, surface conditions, durability, and general ability to withstand the destructive influences of traffic and the weather as measured by field surveys should be given major consideration.

Highway Progress in South Carolina

By Ben M. Sawyer*

South Carolina has as the big mark on its highway progress chart of 1927, five hundred and twenty-nine miles of pavement let to contract. The idea of a State highway system gained momentum since 1917, and in 1920 the State Highway Commission was re-organized by statute and authorized to lay out, construct and maintain State highways. Motor vehicle licenses, Federal Aid and County contributions provided the revenues. Two years later a one cent tax was placed on gasoline.

In 1924 the "Pay-as-you-Go Act" was passed which provided for a designated State System of highways to be constructed and ever after maintained by the State. In 1925 a five cent tax was levied on gasoline; three-fifths was allocated to the Highway Department and the remaining to counties for county roads. The "Pay-as-you-Go Act" authorized any county to construct any of the roads and bridges designated in said Act and to be reimbursed over a period of years for the amount so expended. In 1926, the General Reimbursement Act providing for the issuance of bonds by counties for the construction of State Highways and bridges was passed and in September, 1926, the court validated the Act with a decision that marks the advent of South Carolina's present road building program.

The total estimated cost of the designed system exceeds one hundred million dollars and over forty million dollars of this road-bed investment was expended at the end of 1927. It is conservatively estimated that the revenues of the Highway Department will increase 5 per cent per annum compounded up to 1938, at which time the saturation point will be reached. This assures that the motor vehicle revenues up to 1946 will be sufficient to pay the cost of constructing and maintaining a modern highway system of more than five thousand miles. South Carolina has approximately three thousand two hundred miles of highways with traffic count averages of over four hundred motor vehicles per day and some of these roads carry traffic in excess of one thousand motor vehicles per day. The present annual operation costs of the State motor vehicle fleet approximates fifty million dollars, whereas the State's present annual motor vehicle revenues for the construction and maintenance of its highway system approximates only six million dollars.

The status of the State Highway system as of December 31, 1927, was: Total miles in system, 5,410; miles paved or required to be paved, 3,170; miles constructed or under contract, earth type, 3,898; miles paved or under contract, 898; miles planned and financed, 292; and miles to be paved for which funds have not been provided, 1,980.

In carrying out the construction program, the idea of serving present traffic and paying particular attention to detours and detour signs has been kept constantly in mind. An effort is made to keep our roads in such condition that a motorist can go from one point on the State Highways to any other point on the system without losing his way. Nineteen twenty-eight was started with two hundred and ninety-two miles of paving planned and financed and this, with other projects in negotiation, promises to mark the year by even greater progress than that shown in 1927.

*Abstract of paper presented at the Sixth Annual Asphalt Paving Conference, Atlanta, Georgia, November 28th-December 2nd, 1927.

Highway Accidents Kill 26,618 in 1927

Highway accidents took a toll of 26,618 lives during 1927, the American Road Builders' Association recently stated. The estimates made public include serious injury to 798,700 persons and an economic loss for the year totalling $672,097,000. The economic loss does not include minor damage to motor vehicles or accident insurance premiums.

The highway accident figures are based on an increase of 5.2 per cent over 1926. The American Road Builders' Association reported 25,302 persons killed in that year, in addition to 759,500 seriously injured. The increase of 5.2 per cent was shown in a progress report assembled by the Bureau of Census.

Grade crossing fatalities show a decrease for the first eleven months of 1927, the number of persons killed totalling 2,120 as compared with 2,244 for the same month of 1926. Grade crossing fatalities in 1926 had increased from 2,206 in 1925. The continued increase in the number of highway accidents has caused the American Road Builders' Association to renew its efforts toward bringing organizations interested in the problem into closer co-ordination.

"The unfortunate increase in highway accidents makes imperative an immediate adoption of uniform traffic codes, and an expansion of the nation's road building programs," officials of the association declared. "The human factor is the main element contributing to these accidents, but that human factor could to a large extent be offset by adequate motoring facilities and regulation, coupled with the individual practice of courtesy and caution."

BORROWING FROM THE BANK

How to Establish and Build Up Credit at the Bank

By J. J. Berliner

THERE are many concerns in all lines of business which fail to establish and build up credit at their banks. As a result of this, their business expansion is limited by the lack of necessary capital and not quite a few fail when a period of temporary depression hits them and they are unable to obtain a loan from the bank to tide them over.

Although a great many business executives realize the value of being on a sound basis with their banks, they do not know just how to achieve that position. The thing to keep in mind is that it is the business of banks to loan money and that the main object of a bank is to make money for the stockholders. Because of this, it is more than likely to be more liberal with a borrower whose account shows a good profit than with one that does not.

The carrying of an adequate bank balance is one of the most important essentials in establishing a bank credit. Yet many people do not realize how necessary it is to keep a proper balance. In fact, one often hears it maintained by those who do not understand, that this is merely an arbitrary rule laid down by the banks for the purpose of increasing their deposits.

The following is an illustration, showing what the bank takes into consideration in ascertaining whether an account is profitable or unprofitable; a New York firm kept accounts in two banks, one in New York City and the other in Hartford, Connecticut, both banks granting this firm commensurate lines of credit. The records of the New York Bank showed that although the concern met its notes promptly, kept a 30 to 40 per cent balance against its line, and as an account was in every way seemingly satisfactory. Yet on this account, the New York bank found that it was losing money month after month. A close study of the account for a few months revealed the reason why.

This firm had been depositing in the New York bank only checks transferring funds to New York from its Hartford bank, while it was using the New York bank account very actively for checking out. The result of this practice was that although this firm apparently maintained a satisfactory balance, the balance was made up almost entirely of funds which had not been collected.

Hence the bank had no loanable funds available from this account. And then again, the account was so active—so many checks were put through—that handling cost more than absorbed any money that the bank made from its loans to the customer.

As a rule, a banker considers an account satisfactory, when it is a borrowing account and maintains a satisfactory balance. Such satisfactory balance is generally considered to be about 20 per cent minimum of the line of credit which the customer has been granted.

The average bank figures like this, assume that several customers have lines of credit of $50,000 each. This would mean that they should carry according to the bank's requirements, cash balances of about $10,000. Hence when John Doe comes in to borrow $50,000, the $10,000 balances carried by five other customers is the money loaned to John Doe. Consequently, it can readily be seen that if none of these other customers carry a suitable balance, there will be no money forthcoming for John Doe or else the bank will have to exercise its rediscount privilege at the federal reserve bank. Experience over a long period of time has proved to the general satisfaction of all banks that about 20 per cent of the line of credit, although this is an entirely arbitrary figure, averages satisfactorily.

The good account, therefore, from the bankers standpoint is the one that maintains a satisfactory balance, borrowing sufficiently for its needs, and at the same time is in a position to clean up its borrowings entirely at reasonable periods. And it is to the advantage of the concern to conduct the account in this way, for not only does the concern do its share in helping the bank to keep in funds for their own needs, but it proves to the bank that they can carry on the relations with the bank in a satisfactory manner.

Banks prefer, of course, to have an annual clean up for two reasons: One is that this is the best assurance to the bank that the customer's quick assets are really current, and that he is in a liquid condition; and second, the clean up proves to the bank that its loans are liquid and that its funds are not tied up for indefinite periods.

When money is easy, banks as a rule are not so anxious to have their borrowers keep up their balances as when money is tight, because of the difficulty in placing funds where they can, with safety, make money. On the other hand, when business is tight and the banks have high commitments and more calls for loans than they have available funds, they keep a pretty close watch on the balances to see that they are kept the way they should so that they may have ample funds available.

Besides its borrowing accounts, the average bank has many more times as many non-borrowing accounts. These may roughly be divided into four classes: Active personal checking accounts; active business checking accounts; inactive personal checking accounts; and inactive business checking accounts.

This brings us to the question: "What kind of an account does my bank expect me to carry?" Briefly, the answer is: an account whose average balance is kept commensurate with the activity of the account. For it is unreasonable to expect a bank to keep you when you need help if you have not done your share in keeping your account at least at such a point that the bank does not lose money on it.

Perhaps everyone does not realize that many banks operate a costing method just as do other businesses. The following is a copy of a representative account analysis sheet, a form used in the costing method of one bank. A study of it will throw some light on what the banker expects of his accounts.

The first item is the average daily balance. This minus the average daily amount of uncollected funds, leaves a net balance available for the bank's use. Under the heading of uncollected funds are both checks drawn on other towns and cities and deposited to the credit of the account but which the bank has not yet collected, and checks of the current day that have been deposited too late to go through the local clearing house.

From the net available balance, a reserve must be deducted. This is money or its equivalent that must be kept on deposit with the federal reserve bank, and if the bank is a member bank located in the seventh district of a federal reserve city bank, it is required by law to keep an amount not less than 13 per cent of the bank's net deposits. Reserve requirements with the federal reserve bank by its various members vary in accordance with location from a minimum of 7 per cent to a maximum of 13 per cent on demand deposits. The banks lose the use of this money, as the federal reserve bank pays no interest on it.

Next there is deducted from the remaining available balance a cash reserve which in the case of the particular bank that furnished the analysis sheet is 2 per cent. This is the actual cash on hand in the bank, both in the tellers' cages and in the vaults.

A further deduction is then made for funds kept on deposit with correspondent banks—in the case of this bank also 2 per cent. The bank has full use of the remaining funds.

The first and largest item of income is interest on loanable funds which at the time this analysis was made averaged 4½ per cent. This is a diversified income from five general sources. Banks usually take pains to diversify their investments so as to "get their eggs scattered into many baskets."

The items of income that bring the highest return are money loaned over the counter, and bonds, mortgages, and similar securities which the bank purchases. Then comes government securities, absolutely safe, sound and liquid, but often yielding a lower return—and following these, purchase of commercial paper. However, various conditions in the money market may cause the latter two to exchange places, for governmnet securities average fairly close to the same return most of the time, while with tight money commercial paper may yield as much as counter loans. Commercial paper is always for a term of six months or less, and in the event that a bank needs at any time to liquidate any of its commercial paper holdings, they are always rediscountable at the federal reserve bank any time after 90 days or less from maturity, provided always that the maker of the paper is acceptable to the federal reserve bank. The last, and with the poorest yield of all, is that money which the bank puts in demand loans to brokers, secured by ample and satisfactory collateral.

The second item of income is interest received on the balance of accounts carried with correspondents.

The third item is exchange. Many people do not realize the reason for the exchange charge on certain checks. Checks drawn on several of the principal cities are exempt, while checks drawn on other cities carry the charge. In some cities, the charge does not represent the cost of all the items as is ordinarily thought, but in reality is a deferred interest charge for the time necessary to collect the checks.

This is true where there is no clearing-house rule specifically referring to the crediting of deferred interest. Then it is optional with the bank whether it gives the customer's interest-bearing balance credit at the time the check is deposited. In the event that the bank elects to do it this way, the exchange charge re-imburses the bank for the interest on the amount credited to the customer for the two, four, six or eight days, as the case may be, that the check is in transit and out of the bank's hands.

In other cities—Boston, for instance—no exchange charge whatever is charged on any New England checks. But, under clearing-house rules, exchange items can not be credited to the customer's interest balance until the transit time on the item, as specified by the clearing-house has elapsed.

Concerns that receive a large quantity of small checks from all over the country pay a considerable amount for exchange.

One large firm of publishers receives each day a great volume of checks for amounts of only a dollar or two coming from all corners of the country. To avoid the payment of heavy exchange charges, the concern has made arrangements with a bank located in a small town and deposits all its checks with this bank. As this bank located in the country, does not have to adhere to clearing-house rules, it credits the firm for the full face value of the checks without deducting for exchange. The

bank makes money on this account because the volume of checks is so large that a fair portion of the account represents collected funds. Also interest rates in the country generally averages one or two per cent more than in the large cities. So that, if a large enough balance is maintained to offset delay in receiving funds, the bank has a good chance, even with paying some exchange, to make as much from the account as could a city bank.

Some of Bankers Expense Items

Under the heading of miscellaneous income are service charges for low balances, as for instance, the dollar or two, many banks deduct from the customer's account if his balance average is below the bank's minimum balance requirements. Other miscellaneous and not ordinarily received items of income like Canadian discount, also come under this heading.

The total of these items then, is the entire income that the bank can derive from the net balance which is available for its use, and from this total, the expense of carrying the account must be deducted.

The first expense to be charged against any accounts is interest paid on the balance, provided the bank is paying any. This is paid on the net available balance before deducting the reserves.

The next three items—three types of check collections—are generally those that cause the bank either to make or lose money on an account. The first, transit items, are those checks drawn on other towns. The second, clearing items are checks drawn on other banks in the same town. The third, checks on us, is self-explanatory.

In the bank that furnishes this information, it generally costs about 2½ times as much to handle checks drawn on other towns or cities as it does to handle checks drawn on the same town or city in which the bank is located. Also it costs the bank practically as much to handle checks drawn on itself as it does to send checks to distant points for collection. This to the uninitiated, may seem peculiar, but is simply due to the cost of clerical handling.

Cost of Handling Checks

The routine in handling checks is briefly, as follows: In the handling of transit items the bank classifies the checks and takes a description of each before sending them out. This procedure provides for identification in case checks are lost.

Similarly it costs something for the receiving tellers to take in currency and this is generally charged for at an arbitrary figure such as 20 cents per $1,000 with this particular bank.

The next item is loaning expense. This is a spread of the cost of the bank's loaning and credit departments, allocated in this particular case, at the rate of about ½ of 1 per cent annually of the net loanable money balance.

Under the heading of miscellaneous expense are the cost of collection items, as for instance, sight drafts on bills of lading and coupons deposited for collection. In most banks it includes, as well, such items as credit investigations made for customers and other miscellaneous services of this kind.

The total of these expenses covers pretty thoroughly the actual cost of running an account. This total deducted from the income shows how the account is running from month to month. A loss of one or two dollars a month on an account is a very small item, but when this is multiplied by several thousand accounts, it becomes easy to realize what a leak there can be in any bank that does not watch its accounts very closely.

Information a Bank Desires for Credit

In considering a line of credit for the average business, a bank usually desires the following information:

1. Latest available Balance Sheet; also Balance Sheets for preceding two or three years, if they are not already in possession of the bank. Accounts should be grouped on Balance Sheets to show the Current Assets and Current Liabilities separately from the other Assets and Liabilities. The items in the former group should include the following accounts:

Current Assets

Cash in office and in banks.
Cash margin with banks.
Cash deposits in foreign countries.
Cash advances for goods not invoiced.
Cash in Sinking Fund to be utilized within one year.
Certificates of Deposit with banks.
Foreign Exchange.
Notes Receivable of Customers.
Raw goods.
Goods in Process.
Manufactured Stocks.
Goods in Transit, if included in Accounts Payable.
Goods on Consignment.
Government or Municipal Bonds.
Other Temporary Investments if readily convertible into cash.
Accrued Interest Receivable.

Current Liabilities

Notes Payable—Banks.
Notes Payable—Brokers.
Notes Payable—Merchandise.
Accounts Payable—due within one year from date of Balance Sheet.
Payrolls due and Accrued.
Reserves for Bad Debts.
Reserves for Inventory Losses.
Reserves for Contingencies.
Customers Deposits—
accrued Interest Payable.
Dividends Payable.
Chattel Mortgages.
Notes or accounts Payable to Affiliated or Associated companies.
All other Liabilities, the maturity of which is not specified except Capital Stock.
Bonds or Mortgages maturing within one year.

2. Statement of the manner of valuing goods in inventory. Inventories should be at cost or market, whichever is lower.

3. Amount of insurance carried on plant and the amount on merchandise.

4. Amount of Notes and Accounts Receivable, past due or of doubtful value.

5. Statement of amount, if any, of Notes Receivable, Accounts Receivable, or Merchandise pledged to secure indebtedness.

6. Amount of Notes Receivable under discount; also any other contingent liability, as endorser or otherwise.

7. Full and clear explanatory notes of all unusual items in Balance Sheet, to insure fair consideration of them by the bank. Otherwise the bank, in order to be on the safe side when there is ambiguous wording or lack of detailed explanation, will classify such an item as slow assets, if it is an asset, or among the current liabilities, if it is a liability.

8. Statement of any contemplated construction or capital expenditure during the year, and the means by which it will be financed.

9. Earnings statements and Profit and Loss statements for a period of at least three years. A simple and convenient universal form for this purpose is as follows:

Comparative Earnings Statement

	1925	1926	1927
Sales or Earnings (net)			
Less			
Cost of Goods Sold			
Depreciation			
Other deductions			
Total Deductions			
Net Manufacturing or Trading Income			
Less			
Selling Expense			
Administration Expense			
Other Expenses			
Total			
Net Operating Income			
Other Income			
Net Before Interest			
Less			
Interest on Funded Debt			
Interest on Floating Debt			
Other Charges			
Total			
Net Income Before Taxes			
Federal Taxes			
Net Income Before Dividends			
Less			
Dividends on Preferred Stock			
Dividends on Common Stock			
Other Withdrawals			
Total			
Balance to Surplus			
Credits			
Balance at Beginning of Year			
Earnings for year			
Other Credits Not Applicable to Operation for Year			
Bad Debts Recovered			
Total Credits			
Debits			
Bad Debts Charged Off			
Other Losses or Adjustments			
Total Debits			
Surplus as per Balance Sheet			

10. Statement of amount of depreciation charged off and manner of computing it.

11. Explanation of any unusual condition in connection with the earnings. If they are more or less than normal, it is desirable to state reason; and if earnings are low to state what steps, if any, are being taken to rectify the trouble.

12. A certification of the figures by independent auditors. (This is generally preferred by banks.)

The liquid condition of the business will be determined from the Balance Sheet and the going concern value studied from the Income account which figures should show a steady earning power proportionate to the capital invested.

Bank's Method of Studying Credit Data

It may be helpful in the preparation of the data outlined above, if this subject is followed a little further and a description given of the manner in which a bank utilizes the information.

The segregation of the Balance Sheet into quick and slow assets and liabilities is the first step in determining liquid condition. The next step is a comparison with similar figures for preceding years to see whether the latest figures show an improvement or a less favorable condition.

Another important test to bring out any unusual conditions is made through the method of ratio comparisons. Relationship between items or groups of items when shown by ratios, and compared with average ratios for similar businesses, discloses rapidly and conclusively facts which would otherwise be difficult to detect. Of course, a fixed set of ratios cannot be used in all lines of business, but where there is a variation from the general average it indicates that there is some unusual factor or condition to be investigated and studied to determine whether an exception should be made in the case under review.

Quick Condition—It is, however, a general practice among banks (dependent to a certain extent on the kind of business) to set as general standards that:

Cash should be at least 12 per cent of the amount of the current liabilities.

Cash and Receivables should at least equal the total current liabilities.

Current Assets should be at least double the amount of current liabilities.

Inventories should be about 50 per cent, and never exceed 60 per cent of current assets.

More concretely expressed this may be indicated as follows:

		Percent of Current Assets
Cash	$ 4,800	6%
Receivables	35,200	44%
Inventory	40,000	50%
Total current assets	$80,000	100%
Current liabilities	40,000	
Percent of current assets to Current liabilities		200%

Further Comparisons—It is further held generally that:

Accounts receivable should always represent merchandise transactions and that notes receivable (excluding trade acceptances) should be small in proportion to the accounts receivable, particularly in a business where there is a rapid turnover of merchandise.

Determination of Financial Ratios—To attempt to express the various ratios in figures might be misleading, as some banks work on higher ratios than others, but the manner of computing certain ratios by some credit men is as follows:

Ratio to be Determined	How Determined
Cash Position	Current assets (minus inventory) divided by current liabilities.
Quick Position	Current assets (including inventory) divided by current liabilities.
Inventory Position	Inventory divided by current assets.
Turnover of Capital	Net sales divided by capital, surplus and funded debt at beginning of year.
Net Profit on Sales	Net income before dividends divided by net sales.
Utilization of Plant	Cost of product divided by plant and building account.
Utilization of Net Worth	Net sales divided by amount of net worth.
Fixed Interest Charges	Net income before interest on funded debt divided by interest on funded debt.
Debt Position	Total liabilities except capital and surplus divided by capital surplus.
Fixed Assets Position	Plant and permanent investment divided by capital and surplus.
Trend of Collections	Receivables divided by net sales.
Reserve Position	Reserves divided by total assets.
Contingent Position	Contingent liabilities divided by capital and surplus.
Surplus Strength	Total tangible assets divided by surplus account.

Account Analysis

Name—John Doe. Month—June, 1927.		Total
Average Daily balance		$93,400
Less average daily uncollected funds		200
Net available balance		$93,200
Less 13% Reserve with Federal Reserve Bank	$12,116	
Less 2% Cash Reserve	1,864	
Less 2% Balances with Correspondents	1,864	
		$15,844
Net Loanable Balance		$77,356
Income—		
Interest on Loanable Funds at 4½	$290.08	
Interest Received on Balances with correspondents	2.52	
Exchange charged	12.21	
Miscellaneous Income		
Total Income		$304.81
Expense		
Interest Paid on Balance	$233.00	
Exchange Absorbed		
Transit Items 10@1¾c per item	.18	
Clearing Items 12,189@¾c per item	11.42	
Checks on us 76@2½c per item	1.90	
Currency 404M@10c per M	40.40	
Loaning Expense	32.30	
Miscellaneous Expense		
Total Expense		$399.20
Profit		
Loss		$ 94.39

Notes payable should never exceed the Net Worth; Notes payable for merchandise (other than trade acceptance) should be small, as other wise it indicates failure to take advantage of discounts.

Unsecured notes payable to banks or sold through brokers should not exceed one-third of the Net Worth. (Net Worth is the amount of Capital and Surplus after deducting good-will, trademarks, patterns, etc., except the amount of their known realizable cash value.)

Annual sales should equal and in general be greater than the amount of capital.

Net income before interest should be double the interest on funded debt.

While a bank may have definite standards for the purpose of disclosing weak spots in a business, that does not necessarily mean that it will not make a loan under less satisfactory conditions, if there is confidence in the men running the business, or if other conditions indicate the business is improving its financial position. But all other things being equal, a bank will consider (1) whether the account is profitable; (2) what an analysis of the borrower's credit shows.

The above analysis illustrates that an account with the big balance is not always the most profitable account. That depends as well upon the actual "loanable balance" and the expense item typical items are listed on this "account analysis" —involved in handling the account. Because conditions vary, however, it is impossible to work out a standardized chart by which any account may be judged.

Decline in Canadian Building

There was seasonal decline in the value of Canadian building permits issued during January as compared with the preceding month, but the aggregate was higher than in January, 1927, and also greater than in the same month of any other year since this record was instituted in 1920, according to recent statistics issued by the Dominion Bureau of Statistics, Ottawa. Permits for building estimated to cost $7,709,000 were issued as compared with $11,755,000 in December, 1927, and $5,676,000 in January, 1927.

Quite a Surprise

Geo. E. Wilkes, of East Hampton, Connecticut, writes: "As I told Mr. Munday, I didn't care if I received your Hand Book or not, as I have had so much bunk handed to me in the last 20 years, and I expected something in the same vein. But! When I got yours I apologize, as it is different, and if I had to subscribe to your magazine for five years to get one, I'd get it. I believe, that with a copy of your Pit and Quarry and the Hand Book, I could make a darn good living."

STATUS OF ROCKDUSTING IN THE U. S.

By D. Harrington, J. J. Forbes, and F. Feehan
Chief Engineer Safety Division, Supervising Engineer, Mine Safety Commission
Respectively, U. S. Bureau of Mines

NOTWITHSTANDING the fact that it is now fairly generally recognized that widespread explosions can be almost absolutely prevented in coal mines by efficient rock-dusting and that this rock-dusting can be done thoroughly at a cost which should seldom exceed 1 cent per ton of coal mined, a recent survey of the situation by the Safety Division of the U. S. Bureau of Mines, following a similar survey by the bureau in the fall of 1925, shows that while some progress is being made by our coal-mining people, many entire mining communities are lamentably slow in taking advantage of one of the most effective safeguards available. Much of the information as to the extent of rock-dusting was obtained through the various state inspection departments.

Table 1 shows that in the fall of 1925, about 92 coal companies in the United States were using rock-dust and that in the summer of 1927, the number had increased to 239, or about 160 per cent increase. Similarly, from the fall of 1925 to the summer of 1927, the number of mines using rock-dust increased from 177 to 463, or about 160 per cent increase. This appears to be a decidedly healthy increase, but when it is considered that in 1926 (the last date for which figures are available), there were 7,141 bituminous mines operating and that there were only 463 or 6½ per cent, which were even reported to be using rock-dust to any extent whatever, the foregoing figures as to progress are by no means impressive or even satisfactory.

On the favorable side, table 2 shows that the annual output of the mines using rock-dust in the summer of 1927, was over 137,000,000 tons (as against about 54,000,000 tons in 1925), hence the mines now using rock-dust produce about 24 per cent of the country's bituminous coal. The fact that mines using rock-dust represent but about 6½ per cent of the total number of operating mines, yet produce about 24 per cent of the tonnage, shows that it is the larger capacity mines which are progressive as to this precaution. Table 2 indicates that mines using rock-dust in the summer of 1927, employed about 109,000 underground workers out of a total for the United States of about 510,000, hence only about 21 per cent of the underground workers in our bituminous and lignitic mines are being given at least partial protection by rock-dusting. The rock-dusting survey made in the fall of 1925, indicated that mines using rock-dust employed about 50,000, hence an additional 60,000 were brought under protection by rock-dust since that time.

In 1925 it was found by careful inquiry that rock-dust was used in mines in 13 states, while in 1927, this method of mine protection had been extended to 17 states. In so far as can be ascertained, there is little or no rock-dusting being done in Arkansas, North Carolina, Iowa, Michigan, Missouri, North Dakota, or Virginia. The states in which most general attention has been given rock-dusting in proportion to the total number of mines operated are, in order: Utah, with 100 per cent of the mines reported as using rock-dust; New Mexico, with 43 per cent; Wyoming, with 31 per cent; Alabama, with 23 per cent; and Colorado, with 14 per cent. The columns in tables 1 and 2, under "Major disasters," show that all these states have a bad record for disasters, and the situation as to present-day rock-dusting appears to indicate that at least some of the operators in those states learn by experience.

Pennsylvania, with 129 mines using rock-dust, heads the list of states in number of mines taking this precaution against widespread explosions; West Virginia is second with 89, Alabama third with 52, Utah fourth with 38, and Colorado fifth with 31; then follow Illinois with 25, Wyoming with 19, and Kansas and Kentucky with 18 each.

In the list of major disasters to 1928 (in this case a major disaster means an explosion resulting in 5 or more fatalities), it will be noted that West Virginia has the worst record with 1,730 killed, yet only 7 per cent of her mines are using rock-dust; 1,517 men have been killed in Pennsylvania bituminous mines, hence these rank next to West Virginia in total killed by disasters, yet only 7 per cent of the Pennsylvania bituminous mines use rock-dust; Alabama, with 814 killed, has the third worst record for "major explosions," and as 23 per cent of her mines are using rock-dust it appears that a fair proportion of Alabama coal-mining people are alive to their responsibilities as to at least one protective measure. Colorado, with 719 killed by major disasters, has the fourth worst record; 14 per cent of her coal mines now use rock-dust, and while this exceeds the average of 6½ per cent for mines of the country now using rock-dust, it is by no means what should be expected of a state with Colorado's very poor record as regards explosions. Wyoming with 523 killed in major disasters, New Mexico with 445 killed, and Utah with 376 all have very bad records in proportion to the number employed, and all realize their responsibilities as far as rock-dusting is concerned, as 31 per cent of the mines in Wyoming, 43 per cent in New Mexico, and 100 per cent in

Utah are reported as using rock-dust. In Tennessee, with only 2 per cent of its mines using rock-dust, 380 have been killed in major disasters. In Oklahoma, with 353 killed in major disasters, only 6 per cent of the mines using rock-dust, while Virginia with 353 killed in such affairs, is reported as having no mines using rock-dust; the latter condition is astonishing, as Virginia has many progressive coal-mining men. Probably the lack of rock- that Virginia has not had one major disaster since 1912; however, this criterion is a decidedly poor one on which to base relaxation of safety precautions, as is well illustrated by Utah, which had no major disasters from May 1, 1900 (when approximately 200 men were killed in the Winter Quarters mine), to March 8, 1924, a period of nearly 24 years. On that date the Castle Gate explosion took 171 lives and was followed in September of the same year by the Rains explosion, which cost 5 lives; in both disasters every human being in the mine was killed. Although Illinois has been a large coal producer and its major disaster death list of 305 is relatively low, nevertheless it is astonishing to learn that only 5 per cent of the mines of Illinois are using rock-dust. In Washington, where relatively few are employed, 215 men have been killed in major disasters and many of the mines are gassy and yield explosive dust, yet rock-dust is used in only 10 per cent of its coal mines. Kentucky has a rapidly growing coal-mining industry and is charged with 208 fatalities from major disasters, yet only 3 per cent of its mines use rock-dust. In Indiana 124 have been killed in major disasters; despite a rock-dusting law on the statute books only 4 per cent of the mines use rock-dust, in so far as can be ascertained. North Carolina, with only 3 operating coal mines recorded has had 3 major disasters causing a total of 115 deaths, yet no rock-dusting is being done in so far as information is available. Only 65 have been killed in major disasters in Kansas mines, but undoubtedly more than that number have been killed in shot firers' explosions when only one or two men were in the mine; yet only 7 per cent of the Kansas mines report the use of rock-dust.

In Ohio 36 persons have been killed in major disasters, and there are 625 coal mines, producing in all between 25,000,000 and 30,000,000 tons of coal per year, yet only 2 mines, or not 1 per cent, use rock-dust. In Iowa, 28 persons have been killed in major disasters and 193 mines are operating with an annual production approaching 5,000,000 tons, yet no rock-dusting has been done in the state, according to available information. In Arkansas, 25 have been killed in major disasters, but many others have been killed one or two at a time in explosions; in spite of 99 mines in operation producing approximately 1,500,000 tons annually no rock-dusting has been done. Missouri has lost 24 men in major disasters and moreover has had numerous other explosions killing fewer than 5 each, yet none of the 167 mines operating, producing an annual tonnage around or over 3,000,000, are reported to use rock-dust. Maryland is charged with but one major disaster, in which 16 were killed, yet the mines have explosive coal dust; there are 97 mines in operation with an annual tonnage around or over 3,000,000, yet there is but one mine in which rock-dusting is reported. Montana, with its annual tonnage nearly 3,000,000 from 45 operating mines, apparently has the very enviable record of having escaped major disasters; nevertheless some of the mines are gassy and all have explosive dust, hence having only one mine using rock-dust is by no means a good record. North Dakota, producing chiefly lignite from 150 mines with an annual output of around 1,500,000 tons, and Texas, with 32 mines and an annual tonnage over 1,000,000, have had no major disasters and do no rock-dusting, yet there is absolutely no doubt that under

TABLE 1

	Companies using rock-dust			Mines using rock-dust			Rock-dusting & no. of mines			Major disasters to 1928†				
State	No. 9-1-1925	No. 7-1-1927	Increase %	No. 9-1-1925	No. 7-1-1927	Increase %	No. Operating 1926	No. Using rock-dust 7-1-1927	% Using rock-dust	No.	%	No. killed	%	Explosion* index 1921-1925
Alabama	5	21	320	8	52	550	227 99	52 0	23 0	25 2	9 1	814 25	10 ..	258 249
Arkansas	0	0	0	0	0	0	..	0	0	2	1	12	..	‡166
California	0	0	0	0	0	0	221	31	14	25	9	719	9	158
Colorado	3	26	767	3	31	933	3	0	0	3	1	115	1	9060
North Carolina	0	0	0	0	0	0	3	0	0	3	1	115	1	9060
Illinois	7	14	100	21	25	19	515	25	5	20	8	305	4	59
Indiana	5	6	20	5	8	60	205	8	4	7	3	124	1	167
Iowa	0	0	0	0	0	0	193	0	0	2	1	28	..	4
Kansas	0	18	..	0	18	..	252	18	7	3	1	65	1	83
Kentucky	1	12	1,100	1	18	1,700	695	18	3	16	6	208	8	67
Maryland	0	1	..	0	1	..	97	1	1	1	0	16	..	0
Michigan	0	0	0	0	0	0	9	0	0	0	0	0	0	0
Missouri	0	0	0	0	0	0	167	0	0	1	0	24	..	0
Montana	0	1	..	0	1	..	45	1	2	0	0	0	..	0
New Mexico	4	3	—25	13	15	15	35	15	45	8	9	445	5	1380
North Dakota	0	0	0	0	0	0	150	0	0	0	0	0	..	41
Ohio	2	4	100	2	5	150	625	5	1	3	1	36	..	4
Oklahoma	1	3	200	2	7	250	115	7	6	12	5	353	4	136
Pennsylvania	33	66	100	63	129	105	1963	129	7	46	18	1517	18	42
Tennessee	0	2	..	0	2	..	93	2	2	8	3	380	5	92
Texas	0	0	0	0	0	..	32	0	0	0	0	0	..	0
Utah	20	21	5	29	38	31	38	38	100	3	1	376	5	2104
Virginia	0	0	0	0	0	0	109	0	0	11	4	333	4	0
Washington	1	1	0	?	5	..	51	5	10	12	5	215	3	202
West. Virginia	6	85	4[illegible]	..	..	[illegible]	1201	89	7	43	16	1730	21	110
Wyoming	4	5	25	15	19	27	61	19	31	10	4	523	6	948
Total	92	239	160	177	463	162	7141	463	6.5	263	100	8363	100	100

*Indicating relative rates to fatalities from explosions based upon 1,000,000 man-hours underground. Average rate for U. S. equals 100.
†A major disaster is one in which 5 or more are killed, and in this tabulation all disasters are explosions.
‡Includes Oregon, Idaho and Nevada.

some conditions lignite dust is explosive. Michigan, with 9 coal mines having an annual output around 700,000 tons, has had no major disasters and does no rock-dusting.

The column labeled "Explosion index, 1921-25" taken from page 8 of Serial 2809, Reports of Investigations, U. S. Bureau of Mines, gives the record of the various coal-mining states from 1921 to 1925, inclusive, on explosions. The rates are calculated in fatalities per 1,000,000 man-hours, average for the coal mines of the United States being regarded as 100. It is seen immediately that Georgia and North Carolina, with index 9060 or 90 times the average for the United States on explosion fatalities per 1,000,000 man-hours underground, have a decidedly unenviable record for explosions, yet no rock-dusting is being done as far as is known. Utah, with index 2,104 or 21 times the explosion-fatality rate for the country, has "taken the bull by the horns" and requires rock-dusting to be done in all mines; New Mexico with index 1,380, Wyoming with index 948, and Alabama with index 258 are all making progress in rock-dusting, as heretofore indicated. Arkansas with index 249, Washington with 202, and Indiana with 167 are not using rock-dust to anything like the extent they should. Colorado with 158 index is making a little progress, as 14 per cent of its mines now use rock-dust. Oklahoma, with index 136, and West Virginia, with 110, are adopting rock-dusting slowly. Tennessee, with index 92, has an explosion fatality rate for the 5-year period 1921-1925 slightly better than the average for the United States and is doing very little rock-dusting. Other states with explosion-fatality rates below the average of the United States for the 1921-1925 period are: Kansas with an index of 83, Kentucky with 67, Illinois 59, Pennsylvania (bituminous) 42, North Dakota 41, Iowa 4, and Ohio 4. States with clear record as to gas or dust explosions in coal mines (1921-1925, inclusive) are: South Dakota, Michigan, Texas, Montana, Maryland, Missouri, and Virginia.

Although the situation as regards rock-dusting in coal mines improved much from that in 1923, when scarcely a dozen mines in the United States were using rock-dust, in 1925, when 177 mines used it and in 1927, when the total was 463, numerous phases of the situation are still by no means encouraging. Several states have enacted laws or regulations on rock-dusting, but in general they are essentially inoperative or at least are not effectively enforced. One state with a rock-dusting law has less than the entire country's average of 6.5 per cent of its mines using rock-dust, and few if any of the mines which use rock-dust apply it even approximately adequately. In one state where rock-dusting is required, a mine with several miles of dry, dusty workings spread 7 tons of rock-dust and was considered to have complied with the law. In another state a company purchased a rock-dusting machine and stored it in a warehouse, and was credited with having complied with rock-dusting requirements. Most mines distribute rock-dust where it can be done conveniently from a haulage track and then point with pride to having rock-dusted the mine, although there may be one, two, or more completely unprotected entries with untold quantities of fine, dry coal dust paralleling the rock-dusted one. One mine was widely announced as completely rock-dusted, yet no rock-dust had ever been placed in six out of seven parallel entries; no rock-dust had been placed in rooms or abandoned workings, and no rock-dust of any kind had been placed in this dry dusty mine for nearly a year, although the mine was daily mining about 1,000 tons of coal by the usual coal-dust-producing processes, such as dry undercutting, blasting, shoveling, hauling, etc.

Although the recent survey indicates that rock-

TABLE 2

State	Rock-dusting & No. of mines: No. Op'rat'g 1926	No. using rock-dust 7/1/'27	% using rock-dust	Rock-dusting and production: Total ton. bit.mines 1926	Production mines using-rock-dust Approx. ton- 7/1/1927	%	Rock-dusting and underground employees: Total employees bit. mines 1926	Employees in mines using rock-dust No. 7/1/1927	%	*Major disasters to 1928: No.	%	No. killed	%	†Explosion index, 1921-1925
Alabama	227	52	23	21,000,962	10,900,000	25	23,024	10,304	45	25	9	814	10	258
Arkansas	99	0	0	1,459,017	0	0	2,856	0	0	2	1	25	..	249
California	0	0	0	.....	0	0	....	0	0	2	1	12	..	‡166
Colorado	221	31	14	10,637,225	2,500,000	24	10,854	2,707	25	25	9	719	9	158
North Carolina	3	0	0	.....	0	0	....	0	0	3	1	115	1	9,060
Illinois	515	25	5	69,266,923	19,500,000	28	68,288	15,412	23	20	8	305	4	59
Indiana	205	8	4	23,186,006	3,150,000	14	20,041	2,504	12	7	3	124	1	167
Iowa	193	0	0	4,625,487	0	0	8,192	0	0	2	1	28	..	4
Kansas	252	18	7	4,416,480	830,000	19	6,831	1,803	26	3	1	65	1	83
Kentucky	635	18	3	62,924,462	4,250,000	7	51,664	3,559	7	16	6	208	3	67
Maryland	97	1	1	3,078,353	230,000	..	3,207	162	0	1	1	16	..	0
Michigan	9	0	0	686,707	0	0	1,444	0	0	0	0	0	..	0
Missouri	167	0	0	3,008,495	0	0	4,102	0	0	1	0	24	..	0
Montana	45	1	2	2,797,760	475,000	7	2,002	500	0	0	0	0	..	0
New Mexico	35	15	43	2,817,923	2,160,000	75	2,662	1,503	56	8	3	445	5	1,380
North Dakota	150	0	0	1,370,244	0	0	858	0	0	0	0	0	..	41
Ohio	625	5	1	27,372,488	1,470,000	6	33,852	876	3	3	1	36	..	4
Oklahoma	115	7	6	2,842,673	780,000	27	4,268	1,166	27	12	5	353	4	136
Pennsylvania	1,963	129	7	153,041,638	55,650,000	36	135,959	43,956	32	46	18	1,517	18	42
Tennessee	93	2	2	5,788,741	340,000	6	6,750	460	7	8	2	380	5	92
Texas	32	0	0	1,091,158	0	0	1,414	0	0	0	0	0	..	0
Utah	38	38	100	4,373,793	4,375,000	100	2,943	2,943	100	3	1	376	5	2,104
Virginia	109	0	0	14,133,386	0	0	11,567	0	0	11	4	333	4	0
Washington	51	5	10	2,586,568	895,000	35	2,860	1,135	39	12	5	215	3	202
West Virginia	1,201	89	7	143,509,340	26,580,000	19	99,952	17,507	18	43	16	1,730	21	110
Wyoming	61	19	31	6,512,288	3,215,000	49	4,903	2,308	47	10	4	523	6	948
Total	7,141	463	6.5	573,028,117	137,280,000	24	510,493	108,805	21.3	263	100	8,368	100	100

*A major disaster is one in which 5 or more are killed, and in this tabulation all disasters are explosions.
†Indicating relative rates as to fatalities from explosions based upon 1,000,000 man-hours underground. Average rate for U. S. equals 100.
‡Includes Oregon, Idaho and Nevada.

dust is being used in 463 mines in the United States, it is decidedly improbable that 50 of these 463 mines are adequately rock-dusted. Bureau of Mines field men have reported a number of mines as being at least fairly well protected from widespread explosions where combined rock-dusting and watering systems are in use, but there have been few if any mines reported as being adequately rock-dusted where dependence is placed on rock-dusting alone. Moreover, there are very few mines in which anything like adequate measures are employed to ascertain definitely whether rock-dusting which has been done is or ever was of such nature as to prevent or to limit an explosion.

Herewith are some features involved in adequate rock-dusting of coal mines:

1. All coal mines, other than high-grade anthracite, should be rock-dusted unless they are decidedly wet throughout.

2. In such mines all open accessible parts (including air courses, abandoned rooms, pillars, crosscuts, etc.), which are not decidedly wet should be kept rock-dusted to such an extent that any dust to be found on ribs, roof, floor, or timbers will have an incombustible content of 65 per cent or over; however, as to places which are advancing, while rock-dusting should be maintained to the last open crosscut in accordance with the above requirements if at all feasible, the ribs, roof, and floor of the region between the last open crosscut and the face should be kept wet by the use of hose with water under pressure.

3. There should be systematic periodical sampling of dust from mine surfaces with prompt determination of incombustible content and with subsequent redusting where analytical work indicates incombustible below 65 per cent. In general, surfaces should be sampled at least monthly, but sampling should be done more frequently where there is reason to suspect high combustible. Quick simple methods of sampling and analyzing are available, and every mine which uses rock-dust should have this analytical work done as routine procedure.

4. Concise up-to-date instructions for safe, effective rock-dusting are contained in Bureau of Mines Reports of Investigation Serial 2606, issued in 1924, and in Circulars of Information 6039 and 6030, issued in 1927. Copies of these short publications should be in the hands of all wideawake coal-mining men. In addition, the Bureau of Mines has issued information on rock-dusting in the following publications:

Bulletins 20, 56, 82, 167, 225, 247, 268.

Technical Papers 56, 84, 141, 144, 386.

Miners' Circulars 21, 27.

Cooperative Bulletin 18 (Carnegie Institute of Technology and U. S. Bureau of Mines).

5. Rock-dusting to be effective must be made an integral part of everyday mining operations; this means that mining companies must rock-dust in essentially the same manner that they timber, blast, ventilate and haul. Where rock-dusting becomes daily routine work its cost will be nominal and seldom should it exceed 1 cent per ton of coal produced; and until rock-dusting becomes a part of routine daily coal-mine operation it will remain more or less ineffective, and our coal mines will continue to be subject to widespread explosions.

One unfavorable feature in connection with rock-dusting at present is the tendency to assume that the presence of some rock-dust in some parts of a mine gives the entire mine immunity from disaster. This is a decidedly mistaken view. Rock-dusting to be effective must be done thoroughly, and all accessible surfaces of the mine, including haulage entries, air courses, working or abandoned rooms, pillars, etc., should be kept covered with rock-dust unless those surfaces are wet (not damp); and there should be systematic sampling and analyzing of dust from mine surfaces (ribs, roof, floor, timbers), with redusting wherever the incombustible falls below 65 per cent. It should also be borne in mind at all times that rock-dusting, while an effective preventive of widespread explosions involving coal dust, is by no means a cureall for explosions, hence, even if the mine is well rock-dusted, there should be no relaxation in other measures affecting coal-mine safety, including use of effective ventilation, use of permissible closed lights, of permissible explosives, of permissible electrical equipment, etc. In fact, rock-dusting is but one of the many precautions which should be always kept in effective operation if our mines are to be made safe; and rock-dusting must be done thoroughly if its effectiveness is to be assured.—Reports of Investigations, Bureau of Mines, Department of Commerce.

1927 in Canada's Building

The value of Canadian building permits issued by 63 cities during 1927, was substantially higher than in any other year since this record was begun in 1920, while the cost of building materials was the lowest in the record of the same years, according to statistics released by the Canadian Government. The aggregate for the year, based upon revised statements from civic officials, was $184,614,000, compared with $156,387,000 in 1926, $125,029,000 in 1925, and $148,215,000 in 1922, the previous high total in the last six years. The average index number of wholesale prices of building materials stood at 147.7, compared with 149.2 in 1926, when prices were lower than in any of the six preceding years; the index number of wages in the building trades, compiled by the Department of Labor, averaged 179.3 as compared with 172.1 in 1926. The 1913 figures are the base, equal to 100, upon which both series are computed.

GRAVEL AS AN AGGREGATE FOR CONCRETE

By R. W. Crum, and F. H. Jackson
Committee, E-5, the American Concrete Institute*

THE principal purpose of the report of the sub-committee on gravel of Committee E-5, presented before the 1927 Convention pointed out the inadequacy of the information concerning the effect of the various characteristics which govern the concrete making properties of gravel. Brief discussions and summaries were given on hardness and strength, durability, cleanness, grading, resistance to high temperatures, recommended studies and factors to be considered in specifications for gravel. Among the "recommended studies," it was stated that "further studies of the hardness and strength of gravel particles should be made, and it is suggested that modifications of the standard Deval test and the crushing test are worthy of attention." The purpose of this report is to present a further discussion of the modifications of the Deval abrasion test, suitable for use in testing gravel.

Existing data would seem to indicate that the resistance of gravel to abrasion as was used by the tests developed has little bearing on its concrete making properties, although engineers have given considerable attention to the relation between the resistance of aggregate to abrasion and its concrete making properties. It was evident that the standard Deval test for crushed stone could not be applied to gravel because of the requirements for shape and size of particles composing the prepared test sample. As a result, a number of different investigations were carried out and the attempt was made not only to develop a test suitable for gravel, but also to establish a relationship between the resistance of gravel to abrasion as measured by the various modified tests and that of crushed stone as measured by the standard Deval test.

The tests conducted by prominent engineers and investigators, covered studies of the effect of size and grading of sample, amount of abrasive charge revolutions of cylinder, effect of removing dust through slots in the cylinder, tests of types of abrasion machines other than the Deval and other variables.

The American Association of State Highway Officials tentatively adopted the method of test proposed by A. S. Rea, of the Ohio State Highway Department. The test consists of running a sample of 5,000 grams, made up of 2500 grams of ½ inch to 1 inch material and 2500 grams of 1 to 2 inch material in a standard Deval abrasion testing machine for 10,000 revolutions with six 1⅞ inch cast iron balls added as an abrasive charge. In 1920, the specifications for grading samples was revised to require 1250 grams of each of four sizes ½ to ¾ inch; ¾ to 1 inch; 1 to 1½ inches; and 1½ to 2 inches. The latter method has been incorporated in most gravel specifications of the highway departments. Limiting percentages of wear have been placed at 15 although in a few cases as low as 10 and as high as 25 per cent has been specified, reflecting the judgment of the engineer as no conclusive information has been developed which shows the relation between the results of this test and that of a standard test for stone, or which shows any dependence of the concrete making properties of gravel on its resistance to abrasion, measured in this manner.

The above described method is open to several objections: the test cannot be made on all aggregates since the necessary sizes may not be available; the test sample is not representative of the grading as a whole, if the gravel contains a considerable proportion of sizes finer than ½ inch; and if the sample contains a considerable quantity of crushed particles, the results obtained are not comparable on the same basis as for samples containing no crushed particles.

The sub-committee is endeavoring to collect and correlate available information from the more recent investigations among which is a thesis submitted by Bernard T. Schad to the University of Michigan for the Degree of Master of Science in Engineering entitled "Investigations of Abrasion Tests of Road Gravel" which contains information of value. A considerable number of tests were made in connection with the investigation and the following variables were studied:

Grade of sample was, 1250 grams of ¼ to ¾ inch, 1 to 1½ inches, and 1½ to 2 inches, similar to the method of the American Association of State Highway Officials; 1666.6 grams of ¼ to ½ inch, ½ to ¾ inch and ¾ to 1 inch; 2500 grams of ½ to ¾ inch, and ¾ to 1 inch, with no abrasive charge and with six 1⅞ inch cast iron balls. Tests were made with plain and slotted cylinders and 38 different samples of gravel were used and the cementing value of the abraded materials was determined.

Among the conclusions of Mr. Schad are, that the test using the grading consisted of equal parts of three sizes of material, ranging from ¼ to 1 inch in size seemed to adapt itself to gravel used for gravel roads. It was considered evident that the inclusion of material finer than ½ inch and coarser than ¼ inch was amply justified, due to the important effect which this size had on the results of the wear test. The standard cylinder was believed to be more satisfactory than the

*Abstract of report presented to the twenty-fourth annual convention of the American Concrete Institute.

slotted one, because the test more nearly approached the conditions found on the road. The addition of the six 1⅞ inch cast iron spheres was considered to be an advantage because these tests detected excessive amounts of soft material.

According to E. T. Maddocks, the California Division of Highways has made no close study of the relationship existing between the regular short abrasion and the disintegrated granite test but concludes that the results obtained with a charge of rock of 4200 grams are very close the shot test where the character of the rock is about the same from the large to the small sizes. The rock for the disintegrated granite abrasion test includes the small sizes of which 50 per cent is between ¾ and ½ inch screen and 50 per cent between the ½ inch and number 3 screen.

As a result of an informal conference of A. S. Rea, F. H. Jackson, Wallace F. Purrington, A. T. Goldbeck and Stanton Walker, a proposed method of test for abrasion of gravel was made. The first test proposed consists of 5000 grams of four gradings of washed and screened dry gravel placed in the cast iron cylinder of the Deval abrasion testing machine as specified for the standard abrasion test for stone. Six cast iron spheres 1.875 inches in diameter and weighing approximately .95 pounds each shall be placed in the cylinder as an abrasive charge. The cylinder shall rotate 10,000 times at the rate of 30 to 33 revolutions per minute. The material shall be then screened over a number 12 mesh sieve and the material retained on the sieve shall be washed, dried and weighed. The difference between the weight and the weight of the original sample, expressed as a per cent of the original weight, shall be considered as the loss by abrasion.

If gravel contains 15 per cent crushed pieces, it shall be tested as crushed gravel. In such cases, the abrasion test shall be made on a representative sample of the whole including the crushed pieces. The per cent, by weight, of crushed pieces shall be determined and the permissible per cent of wear which shall govern for any given sample shall be calculated.

A number of organizations, notably the Bureau of Public Roads, the Ohio State Highway Department and the New Hampshire State Highway Department have volunteered to conduct investigations along the lines indicated. The Committee expects to study the results of tests on the different gradings of samples recommended and hopes to make recommendations for limitation on the loss by abrasion.

Cement in Paper Bags from Sweden

An interesting development reported in the foreign cement trade of Sweden is the increased use of paper-bag packing. A firm of exporters in Stockholm states that it now ships from 30,000 to 40,000 bags of cement per month to South America.

Highways in British Columbia

The province of British Columbia, though well provided with water transportation on the coast area, has until recent years suffered from an isolation caused by lack of arterial highways from east to west and from north to south. Up to the summer of 1927, highway traffic from eastern British Columbia has been obliged to traverse the State of Washington in order to reach the west coast. Only a portion of the north and south highway is yet complete, though the Ministry of Public Works is making an effort to promote extensions of the road as far north as Prince Rupert and as far east as the Peace River country.

The motor car has been the greatest contributing factor in the advancement of highway building in the Province. The mileage of roads good for automobile traffic has increased during the past decade from 13,000 miles to 17,000 miles; that is, 400 miles annually, not including the considerable mileage of narrow wagon roads that have been widened, surfaced and otherwise materially improved. During the same period the number of registered motor vehicles has increased from 15,730 to 75,482, the 1927 registrations exceeding those of 1926 by 12 per cent.

The Province has an estimated asset of some $50,000,000 in improved highways, $3,000,000 in trails (exclusive of mining trails), $11,000,000 in bridges, $400,000 in ferries, and $750,000 in highway plants.

The construction during this 10 year period includes 800 miles of hard-surfaced, macadam, or gravel main-trunk roads, and 650 miles of non-improved trunk roads. Of laterial roads improved, macadam and gravel comprise 180 miles, dirt roads 600 miles, industrial and mining roads 370 miles, and settlement and farm roads 1,350 miles, making a grand total of 3,950 miles. During this time there were 2,400 miles of trails built, of which 1,400 miles were used for mining operations. British Columbia now ranks third among the Provinces of Canada in highway development.

Cement Kilns

The output of a rotary cement kiln is increased by causing the gases to pass through at a speed substantially greater than that normally maintained. Preferably a speed of not less than 30 feet per second is maintained in the clinkering and decarbonating zones, and 22 feet per second in the drying zone, as compared with 22 and 16 feet per second respectively in normal working. The gases may be drawn through the kiln by a fan, which is protected from overheating by sprays or jets of water, or by passing the gases first through a waste heat boiler. Variations in speed may be produced by varying the cross sectional area of the kiln in different zones. G. Martin (British Patent 282,868).

PRODUCING ARCHITECTURAL SLATE

By F. A. Westbrook

MARBLEIZED slate for decorative and architectural purposes, tile floors and garden walks, as shown in the illustration, slate for switch boards and other electrical purposes are the unique specialties marketed through the Vermont Structural Slate Company. It also finds a ready and receptive market for roofing slate and many other classes of slates quarried and prepared for the different uses.

Since 1859, the Fair Haven Marble Company, the Marbleized Slate Company and the Vermont Structural Slate Company of Fair Haven, Vermont, have been combined to produce and market different classes of slate for various purposes. This places the company among the oldest slate producers in the country. Its chief ambition, that of having a following of satisfied customers, has been attained to a degree enjoyed by those who give their best to the work in hand.

A decidedly important part of the management of a slate business, in the opinion of Mr. A. L. Carpenter, assistant general manager, is the maintenance of carefully planned contacts with architects and contractors. While traveling salesmen are not employed, yet a representative from the mills makes frequent trips to large industrial centers and personally calls on manufacturers, architects, owners, contractor and agents who write business in certain sections. The products are also advertised in a nationally distributed catalog.

Mill No. 1 and Office.

Six quarries, located at Fair Haven, Castleton and Poultney are being operated to supply the

A Splendid Example of the Application of Slate.

Electric Shovel Opening Up New Quarry.

Hoisting Engine for Cableway of New Quarry.

Receiving End of Mill No. 1

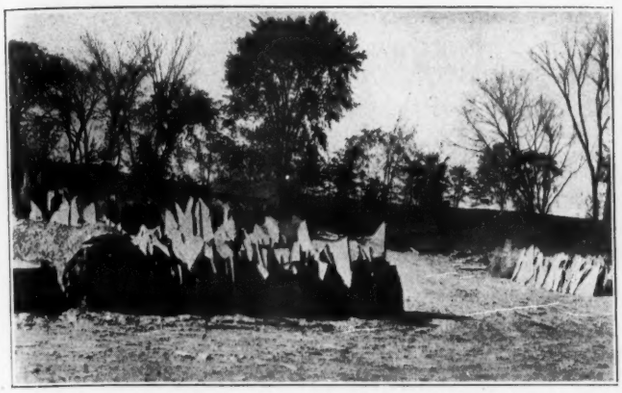
mills. A new quarry has recently been opened near Fair Haven, which is yet in the preliminary stripping stage. An Insley caterpillar traction gasoline shovel, the only gasoline shovel in the district, has just been received, is used for stripping the over-burden. Later it will be utilized to handle material in the quarry. A derrick and cableway, equipped with a Lidgerwood electric hoist have been installed with Roebling wire rope for the cableway and hoist. Waterbury rubber insulated wire is being used for safely conducting power to all parts of the quarries and mills.

Important changes in quarry equipment and practice have occurred since this combination has been in business, according to a statement made by Mr. Carpenter. For example, he is now using well drills, mostly cyclone, which have greatly increased the output and improved efficiency. The jackhammers, usually operated by compressed air, have greatly simplified operations. Ingersoll-Rand, Sullivan and Denver drills are generally used in the quarries. Most of the supplies for both quarries and mills are obtained through the Norton Hardware Company.

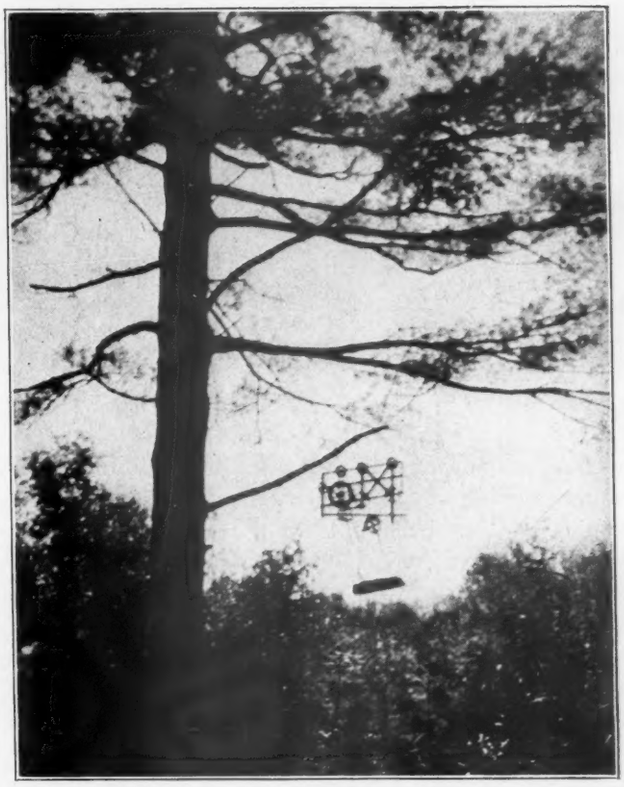
Mills in which architectural slate is produced are of necessity much more elaborate than those in which only roofing slate is manufactured. The two Fair Haven mills are examples of the group and we shall briefly discuss their equipment. Slate is brought in from the quarries by Mack and Ford trucks from which it is removed by a derrick, operated by a small Lidgerwood electric hoist. The slabs are then set on cars which are pushed into the mill and unloaded by Yale hoists.

In Mill Number 1, there are five Ruggles saws, five Ruggles planers and a grooving planer, two Lincoln Iron Works rubbing beds, a carborundum machine designed by company engineers and one from the Gray Iron Foundry, numerous Chicago Pneumatic hand tools supplied with air by an Ingersoll-Rand compressor, and seven machine tools, including two lathes, four drills and one hand saw.

One part of Mill Number 1 is used to cut pieces



Flagging Yard Near Mill No. 2.



View, Showing New Cableway.

for electrical purposes and slate to be marbleized. Since the greater part of the product is marbleized, a department is maintained exclusively for that work. According to Mr. Carpenter, this art was perfected in England and the same method has been used for many years. It is accomplished by floating streaks of paint on a tank of water and dipping the slate. Materials for that department have been supplied by the Chase, Roberts Company for more than 50 years.

Mill Number 2 is equipped with five Ruggles saws, three Ruggles planers, two Patch rubbing beds and the necessary hoists. It is in this mill that the floor slate for interiors is finished. This must be furnished in standard sizes of various colors because the setters are accustomed to regulation sizes and it eliminates cutting on the job. Where experienced setters are employed, various sizes are preferable as they give a more artistic appearance. These demands make it advisable to be prepared to furnish either class. Square edges are preferred as perfect squares make better joints.

Power for all this machinery is purchased electricity or supplied by a 24 inch Morgan Smith vertical turbine, located at a dam owned by the company. The purchased power and company

Receiving End of Mill No. 2.

Hoist House for Cableway.

generated power will operate in conjunction or separately as conditions warrant. Rhoades oak tanned leather belting is used in all of the mills, with the exception of wet locations where Goodyear rubber fabric is substituted. Mill Number 1 has 2400 feet of steam piping for heating purposes.

Large quantities of flagging of various colors for garden walks, as shown in the illustration of Number 2 yard, is kept on hand at all times. The colors used are clear purple, mottled purple and unfading green. Particular stress is laid on selecting the proper colors, harmonizing with a given set of surroundings. The preparation of flags is a simple process as they are not necessarily of uniform shape and size. They are split by hand, sawed or cut with a slate trimming machine, or cut with a knife, making them approximately one inch in thickness.

Slate flooring for a number of buildings, including the First Presbyterian Church at Glenn Falls, New York; Park Avenue Baptist Church of New York City; the School of Architecture, Princeton University; and flagging for several famous gardens such as League Island Park, Philadelphia, has been furnished by these mills. For many of the contracts, the flooring is planned and laid out at the mill and delivered to the building with blue prints and design with due regard for grade and color arrangement. Slate for building purposes is marketed under the name of the Vermont Structural Slate Company.

Commends Pit and Quarry

Louis Simpson, of the Albert Mines, Albert County, N. B., Canada, writes the editor of Pit and Quarry as follows: "I take this opportunity to congratulate you upon the technical journal you so efficiently edit. I glean, from every issue, much valuable information."

Aluminates

Aluminum phosphates are decomposed by being heated to 900 degrees C. or over with alkali salts, and alkaline earth compounds such as oxides, carbonates, sulphates or chlorides. The product is extracted with water to separate alkali aluminate from which alumina may be prepared, and to leave a phosphate, which is soluble in ammonium citrate and useful as a fertilizer. L. Jackson (British Patent 283,072).

Mill No. 1, from the Bridge over the River.

CEMENT, LIME AND GYPSUM DISCUSSED BY A. S. T. M. COMMITTEES

SPRING group meetings of the committees of the American Society for Testing Materials were held in Washington at the Mayflower Hotel on March 21, 22 and 23. These group meetings were quite impressive with more than 475 members gathered together for the sole purpose of advancing the work of the standing committee. The committees met early and late, starting with sessions in the morning with some extending until midnight. In all, twenty-six committees took part and about ninety-four meetings were held.

A local committee, consisting of Jerome Strauss, chairman, E. F. Kelly, A. T. Goldbeck and J. W McBurney, is to be credited largely with the success of the meetings. The officers of the American Society for Testing Materials are: president, H. F. Moore, Professor Engineering Materials, University of Illinois; vice president, C. W. Thompson, Chief Chemist National Lead Company; vice president, T. D. Lynch, Consulting Metallurgical Engineer; secretary-treasurer, C. L. Warwick. The work of those committees of interest to the Pit and Quarry Industries was as follows:

Committee C-1 on Cement held a very interesting meeting on March 22nd. Much of the discussion was centered about the tests that the committee has had under way during the past year or more. These tests have been conducted by 47 laboratories on 32 brands of cement. Data were presented from the viewpoint of time of set, fineness of cement, consistency used and strength developed in the form of the usual standard test specimens, and briquets and compression test specimens made from a neat paste containing 42 per cent of water. These data were reviewed and reports thereon approved for inclusion in the annual report of the committee.

Committee C-7 on Lime held a meeting on Wednesday, March 21, at which the actions to be recommended by the committee in its annual report were discussed. The committee is recommending the advancement to standard of a number of definitions relating to the lime. The committee's methods for measuring the plasticity of lime are being slightly modified in reference to the requirements for the base plate used in the plasticimeter.

As an outgrowth of discussions in the committee during the past year as to the desirability of formulating specifications for lime plastering, the committee gave consideration to a plan that had been proposed for the formation of a Joint Committee on Specifications for Plastering upon which would be represented the various organizations interested in the development of plastering specifications with reference to lime, gypsum and cement plaster. This plan brought forth considerable discussion and it was finally decided to refer the question to the whole committee for a letter vote upon whether the Lime Committee could wish to participate in the activities of such a joint committee.

Committee C-11 on Gypsum, at its meeting held Thursday, March 22, at the Hotel Mayflower, Washington, D. C., considered and approved a proposed program of tests to be conducted at the U. S. Bureau of Standards to determine the working stresses in gypsum fiber concrete. Several very interesting reports were received on investigations now under way covering the value of gypsum anhydrite mixes as a retarder in portland cement. . . This is of considerable importance to the portland cement industry as offering additional sources of available material for use as a retarder.

The committee discussed a proposal for the formation of a joint Committee on Specifications for Plastering upon which would be represented the various organizations interested in the development of plastering specifications with reference to lime, gypsum and cement plaster. After full discussion the committee voted to approve the formation of such a committee and to participate in its activities provided that the plan met with the approval of the gypsum industry.

At the meeting of Committee D-4 on Road and Paving Materials held on Friday, March 23, at the Hotel Mayflower, Washington, D. C., interesting developments were reported in connection with both bituminous and non-bituminous materials. Among the former a complete form of practice for the inspection of bituminous paving plants engaged in the production of all classes of bituminous paving mixtures was presented and recommended for adoption.

The section having charge of the development of a new distillation test presented a report showing marked progress in establishing the accuracy and adaptability of the new distillation test when carried on by gathering in a single laboratory, representatives of a number of state highway departments and several large industrial organizations who conducted the test simultaneously on identical samples with very concordant results.

Along non-bituminous lines, a report dealing with materials, proportioning and curing methods for portland cement concrete pavements and bases was presented and recommended for publication with a view to eliciting criticisms, which should make possible the preparation of a detail specification for these features of concrete pavements and base construction within about a year's time.

Following the regular meeting of Committee D-4 an organization meeting of the newly created Sectional Committee on Methods of Test for Road and

Paving Materials, functioning under the procedure of the American Engineering Standards Committee, and whose personnel is identical with that of Committee D-4, was held; at which it was voted to submit the following A. S. T. M. methods to the A. E. S. C. for approval as American Standard, subject to approval by letter ballot vote of the committee: For Determination of Bitumen, for Penetration of Bituminous Materials and Float Test for Bituminous Materials.

A Technical Committee, of Committee E-1 on Methods of Testing, on Coarse Screens, has been studying the possibility of effecting some standardization in the screens used in the mechanical analysis of coarse materials. Two general types of screens are at present employed, namely square-mesh screens and screens having round openings. Confusion develops, especially in the road-building industry, due to the fact that it is not always clear which type of screen is employed.

The Technical Committee considered the various factors involved at a meeting held at the Hotel Mayflower in Washington, on March 22. A very extensive series of tests has been carried out by the committee to learn if either type of screen gives more consistent results than the other. Other factors involved are the relative costs of installation, the relative costs for replacement, the degree of accuracy of screens as manufactured and the ability to maintain this accuracy in use, length of time required in making tests and to secure a satisfactory end-point, and the extent to which the two types of screens are employed in industry. Recommendations of the Technical Committee will be considered by Committee E-1 on Methods of Testing at its next meeting.

Committee C-3 on Brick at its meeting held on March 23 took action to submit a number of specifications to the Society as tentative. Among these are new tentative specifications for concrete brick and tentative specifications for sand lime brick. These, together with the present Tentative Specifications for Building Brick, will meet all the demands for specifications. The present Tentative Specifications for Building Brick are being revised.

The present Tentative Specifications for Paving Brick are also being revised. A definition for the term brick is being submitted as tentative upon review of the Society's Committee on Nomenclature and Definitions. The very important subject of weathering properties of brick is being recommended for study by a joint committee so that all those interested in weathering properties, which involves a number of materials, will cooperate on the one committee.

A tribute to the system of good roads in the United States has been made by the Mexican government in the form of an Aztec Mosaic fireplace presented to the American Road Builders' Association at Washington. The fireplace has been installed in the association offices.

New Zoning Legislation in 23 States

Local zoning ordinances must be based on authority granted to the city or town by the state government, and hence the enactment last year of zoning legislation in 23 states is of underlying importance to the zoning movement, according to Dr. John M. Gries, chief of the division of building and housing of the Department of Commerce.

The division's canvass of the situation, which involved the searching of the laws passed by more than forty state legislatures which met last year, also revealed the fact that the standard State zoning enabling act, which was prepared five years ago by a committee of eminent men appointed by the Secretary of Commerce, has now been used wholly or in large part in laws enacted in 29 states.

The zoning legislation adopted during the year 1927 ranges all the way from complete state acts applying to all classes of municipalities, to acts that apply to a single city. By the end of the year 1927, zoning laws had been enacted by 45 states and the District of Columbia, while in another state it has been held that zoning is permissible under home rule provisions of the state constitution. The names of 63 cities, towns and villages which adopted zoning ordinances during 1927 have already come to the division of building and housing. This increases the number of zoned municipalities in the United States to 583, with a population of more than 31 million inhabitants, according to the 1920 census, but probably well in excess of 35 million if growth since 1920 is taken into account. More than 57 per cent of the urban population of the United States is represented in these 583 places. Fifty-five of the sixty-eight cities which in 1920 had more than 100,000 population each, now have zoning ordinances in effect, and zoning activities in the remaining thirteen unzoned cities of that group are in various stages of development. At the other end of the list with respect to size, 53 municipalities of less than 1,000 population are zoned.

Aluminum and Cement

The use of aluminum for the production of porous concrete, contrary to the results of other investigators, is found to be unsuitable. It is too expensive and uniform results are very difficult to obtain. For example, the completeness of the mixing with the cement influences the product greatly. The presence of colloids acts as a protective on the aluminum, inhibiting the action of the alkali with evolution of hydrogen gas. Finally, the compressive strength of porous concretes made with aluminum and the necessary amount of sand is too low to be of technical importance.

BITUMINOUS TREATMENT OF GRAVEL ROADS

By F. G. Lang
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Engineer of Tests and Inspection, Minnesota Highway Department*

THE application of bituminous materials to the surface of earth and gravel roads is not a new idea. Tar and oil were used on roads when automobiles were built to resemble buggies even to the extent of being provided with whip sockets. However after a few years, interest in this type declined, due, I think, to an inadequate maintenance organization, and the fact that the large increase in the number of motor vehicles made the pavement of main roads necessary. About 1924 there began a revival of interest in the development of surface treatments.

There is at present a considerable variation in the methods of applying bituminous material in surface treatments and the kind of bituminous material to use. I consider that the term includes all treatments where the bituminous material is sprayed over the road surface, whether it depends on a penetration into an existing road surface, or the mixing of the bituminous material and the material on the road by means of blades or drags or a combination of the two. Rarely is the bituminous surface treatment over two inches thick unless it has been applied over a number of years and gets deeper by scarifying and re-mixing. Any hauling of a pre-mixed material on to a road would not be included as a surface treatment, and by title this paper does not include treatments of broken stone roads or earth roads unless the treated earth road is considered as a subgrade for some type of surfacing.

A considerable variation in methods of applying bituminous material on gravel roads is to be expected for two reasons. First, bituminous surface treatments are now in the experimental or developing stage. Second, there is a considerable variation in the types of gravel roads in various sections, and also in subsoils, drainage, climate, and traffic requirements. Any natural soil road which has been covered with gravel is ordinarily considered a gravel road, yet there is a vast difference in construction methods and materials used. Some gravel roads have been constructed in two or more courses in the so-called trench method, using large stone, especially in base course, with a small amount of fines, and about ten inches total thickness, quite similar, in fact, to the old water-bound macadam construction. As a contrast to this we have the feather-edge method used in Minnesota: gravel with a one inch maximum size and with a large percentage of fines, up to 60 per cent passing a 10 mesh sieve, is placed on a prepared, flat subgrade and compacted under traffic. The total thickness at center is rarely over six inches and approaches zero thickness near shoulder line. The amount of clay binder also varies. A gravel surfaced road is primarily a cheap road and local material must be used without too much cost in its preparation. The type of bituminous material to use largely depends on the non-bituminous materials in the road surface.

At present bituminous surface treatments are becoming very popular for the following reasons:

(1) Eliminate dust. This adds to the comfort of the motorist as well as the resident along the highway, especially in municipalities, and also adds to safety.

(2) Conserve material. Estimates place the amount of material lost from an untreated gravel surface road at about 1 inch to 1½ inches per year, depending, of course, on the amount of traffic. This would mean about 400 cubic yards per mile per year, the value of which, in turn, depends on the cost of gravel and ranges probably from $400 to $1500 per year.

The conservation of the gravel in a territory is greatly affected. In many localities the supply of gravel is rapidly being depleted. This means that not only will we have long hauls to the road which will mean more expensive gravel, but that none will be left for township and secondary roads where the gravel for surfacing would have lasted a long time. This is very important as a good system of secondary and township roads is essential in a complete highway system.

(3) Lower maintenance and vehicle operating costs. This, in turn, depends on the amount of traffic. Statistics compiled in Minnesota show that the maximum economical limit for gravel roads is about 600 cars per day, while our bituminous treated roads are carrying up to 1500 vehicles per day without any signs of distress. The saving to vehicle operation can be computed from some of the figures compiled by Professor Agg. We consider that a properly maintained bituminous surface road should have very little, if any, more resistance to traffic translation than asphaltic concrete. On this basis the saving for 1500 ton miles per day would be about $17.00 or $5100 for a 300 day year.

(4) Better riding surface. Our experience has shown that the maintenance department is able to maintain a smooth riding surface on bituminous surface treated roads practically throughout the year. The untreated gravel road gets sloppy after

*Presented at the Fourteenth Annual Michigan Conference on Highway Engineering held at the University of Michigan, Ann Arbor, Feb. 14th to 17th, 1928.

rains and during a dry period it seems to be practically impossible to entirely eliminate chatter bumps and rhythmic corrugations or washboards.

(5) Gradually build up a surface crust which if on permanently graded roads will provide better foundations for pavements.

I shall not attempt to give the details of construction used in various states. Numerous papers have been published during the past year describing these in detail. Among the states most active in the present development of bituminous treatments are Oregon, California, Nevada, North and South Carolina, Wisconsin, Michigan, Illinois, Indiana, Ohio and Minnesota. While a study of the methods used in the various states is essential, we must keep in mind that bituminous treatment, for the reasons already given, is a local problem. Not only do the conditions in one state vary from those in another, but there are also big variations within one large state. I shall now describe conditions as we have them in Minnesota and the methods used. Our bituminous surface treated roads may, in general, be divided into three classes:

(1) Those sections where the subsoil is a sand and the gravel surfacing is deficient in binder, as usually occurs in sandy areas. The more ¼ to ¾ inch stone in the gravel surface the better the results.

(2) Compacted clay and gumbo subgrades which have been treated prior to a light application of gravel. The roads treated have either been located in sections where gravel surfacing had to be shipped in and is very expensive, or on certain gumbo subgrades which appear to eat up the gravel during wet periods. Minnesota does heavy grading in these sections, running 14,000 to 20,000 yards per mile for a 30 foot road. This brings the surface of the road from four to five feet above the bottom of the ditch line and the ditches are usually quite wide. I do not believe our treatment of this class of roads would be successful if it were not for the high grade line which adds to the stability of the road bed.

(3) The treatment of gravel surface roads on clay and loamy subgrades.

I will now discuss each class in more detail.

A typical analysis of the subgrade in the sandy area is as follows:

Retained on 10 mesh sieve	0.5%

An analysis of part passing No. 10 is as follows:

Total sand	90.2%
Total silt	5.5%
Total clay	4.3%
Cementing value	2.0%

A typical analysis of the surfacing used on this type is as follows:

Passing 1 inch retained on No. 10	65.0%

An analysis of part passing No. 10 is as follows:

Total sand	95.0%
Total silt	3.1%
Total clay	1.9%

Of course there are variations from this typical analysis. We have used both tar and asphaltic cut-back oils for these conditions. The number of miles of tar is 120.3. The number of miles of asphaltic cut-back oil is 1. We have been well satisfied with our tar treatments. The asphaltic cut-back oil is really an experimental piece. A typical analysis of the tar used is as follows:

Water	——
Specific Viscosity (Engler 50 cc. at 40°C.)	11.7
Total bitumen	97.41
Distillation:	
0—170°C.	1.4
0—270°C.	22.8
0—300°C.	29.9
Softening point	44.2

A typical analysis of the asphaltic cut-back oil used on the one mile experimental piece is as follows:

Specific Gravity	.948
Flash	76°C.
Specific Viscosity at 60°C.	11.2
100 penetration residue	60.4
Ductility of residue	58
Loss at 162°C.	13.0
Total bitumen (Soluble in CS_2)	99.94
Total bitumen insoluble in 86° Naphtha	17.43

The method of application is as follows:

The first operation consists of grading all of the loose material to the center of the road, thus forming a smooth hard surface. In only a few instances have we resorted to sweeping. The ideal road surface at the time of the first application should be smooth, well compacted, dry, and free from dust.

The second operation is the spraying of the prepared surface with about ¼ to ⅓ gallon of tar heated to about 130°F.

Third operation. After about 24 hours, or when the first application has completely penetrated and set up, the surface is again sprayed with ¼ to ⅓ gallon of tar, and at once covered by blading the loose material previously removed on to the fresh tar. In case the bladed material contains an excess of fines of a non-granular nature, it is wasted over the shoulder, and suitable material for covering is windrowed on the opposite shoulder, bringing the total amount of covering material up to about 350 cubic yards per mile. The best covering material is pea gravel (retained No. 10 passing ⅜ inch screen), and where gravel plants are near this is used; usually, however, selected local deposits have been used.

Fourth operation. The opposite side of the roadway is then cleared with a grader, throwing the loose gravel into a windrow over the edge of the tar section and leaving the opposite side free for treating.

Fifth operation. The remaining side is treated with penetration coat and allowed to set up the same as the first side treated.

Sixth operation. This side is then treated with second coat of tar and loose graded material bladed in from side for cover the same as before.

Seventh operation. The roadway is dragged a number of times to smooth it and work all the gravel possible into the tar. This dragging operation is continued for a period of three to five days or until the surface has set up to such an extent that dragging does not do any good, or the surface at that time is in a hard condition. At this time any small breaks or holes should be immediately patched with pre-mixed material, using the same grade of tar and the same material as is used for the cover coat. If large holes develop, a coarser grade of road metal may be used to insure a more stable patch. At completion, the crown for a 30 foot top would be from 6 to 9 inches. This method is really a combination of the penetration and surface mixing methods. Its success depends largely on penetration into compacted surface. We find this makes a good bond between old road bed and surface, and we have had very little trouble with creeping of surface.

On this type of road the daily traffic varies between 700 and 1500 vehicles per day. Initial cost for 24 foot surface ranges between $1600 and $1800 per mile. The cost of maintenance varies between $300 and $600 per mile per year. One patrolman with occasional auxiliary equipment can successfully handle 20 miles of this kind of road, taking care of the patching, cutting of grass, repairing washouts, etc.

Of the second class, treated subgrades, we have 131 miles. The subgrades treated have been in the extreme southeastern and northwestern parts of the state. A typical analysis of the subgrade in southeastern Minnesota is as follows:

Passing No. 10 sieve	99.8%
Total sand	1.5%
Total silt	56.8%
Total clay	41.7%
Cementing value	135

A typical analysis of the gumbo soil in northwestern Minnesota is as follows:

Passing No. 10 sieve	99.5%
Total sand	8.6%
Total silt	21.8%
Total clay	69.6%

In all of our subgrade treatments we have used a straight distillation midcontinent residum. A typical analysis of the oil most used is as follows:

Specific Gravity	1.044
Flash	164°C.
Specific Viscosity at 60°C.	12.9
100 penetration residue	65.2
Ductility of residue	100+
Loss at 163°C.	2.8
Total bitumen (soluble in CS_2)	99.91
Total bitumen insoluble in 86° Naphtha	16.23

The method of treatment is quite similar to the method just described for tar treatment. Considerable care is taken to see that the subgrade at the time of treatment is well compacted, smooth, free from dust, and dry. Weather conditions play a great part in the application of oil on this class of work. Warm weather aids the penetration of the oil into the subgrade, and rainy weather tends to slow up the work because it is hard to get the surface dried out sufficiently to allow a penetration into the grade far enough to get the depth desired.

About 400 cubic yards of cover material per mile is used. The cover material as previously described is preferably pea gravel, but usually selected local deposits are used. The gravel takes the wear. Too much emphasis cannot be placed on having the surface of the road well above the water table.

In the third class of treatments, the gravel surface on clay and loamy subgrades, I am unable to give any typical analyses of the subsoil or gravel surfacing. Included in this class are the intermediate soils between sand and clay. The surfacing also varies, but, in general, where we have clay subgrades there is considerable clay binder in the gravel surfacing; however, it is not uniformly distributed. Belonging to this class of roads we have 21 miles of tar, 17 miles of asphaltic cut-back oil, and 96 miles of mid-continent residuum. The choice of bituminous material to use is made after an examination and analysis of the composition of the gravel surfacing and the subgrade, also taking into consideration the thickness of the compacted gravel surface. I am unable to give any definite figures on which the decision as to the class of bituminous material to use is finally made. In general, tar and asphaltic cut-back oils have been the most satisfactory on granular soils, and the straight run residuum on the heavy soils. The method of application is entirely similar to the method previously described for tar treatment on granular soils.

When necessary to use the road during time of construction, we endeavor to protect the motorist from temporary inconvenience in the following ways:

(1) We keep one-half of the road in such condition that traffic can go over it without getting into the freshly placed material.

(2) We place warning signs at the ends and along the section being treated informing the motorist what to do.

(3) Patrolmen are placed at the ends to stop the motorist and tell him how to proceed.

At the same time we expect the cooperation of the public and there have been times when it has been necessary to have police power bestowed on patrolmen to enforce requirements, that is, in driving with unnecessary speed on freshly laid material.

Bituminous surface treatments must not be considered in the same category as hard surface pave-

ments. At the present time it appears to be the best solution for that large mileage of intermediate roads where the untreated road is not satisfactory and the traffic is not sufficient, or money not available for pavement. At present this type of surface is extremely popular with the traveling public. In Minnesota the maintenance and construction of all primary highways, including routes through cities, is entirely under the jurisdiction of the Highway Department. Further than that we have one specially trained man who is put in immediate charge of bituminous treatments. No roads are treated without a special examination of local conditions. During construction we place inspectors in charge of the various projects, who work directly under one head. It is also the duty of the man in charge of this type of treatment to follow up the maintenance and see that the local officials in charge take care of the road.

We consider that many bituminous treatments are still in the developing and experimental stage. We always try out new material, which we think might be satisfactory, on a small scale. New methods are being developed. Regardless of purchase price, we do not buy any large amount of new bituminous material until experience has shown that it is satisfactory.

Nevertheless, I am not entirely satisfied. Our field work has proceeded faster than our laboratory research although this has not been entirely neglected. We should develop some laboratory method for ascertaining what particular bituminous material would be most satisfactory on the particular soil to be treated. Field results show a considerable variation in the properties of road oils complying with one specification. It is difficult to find a man with adequate training and sufficient enthusiasm to successfully carry on research work of this character, especially for the salary that there is usually available. Much money will be wasted throughout the United States during the next few years because basic principles and tests have not been established.

Data on Rents and Values Wanted

A comparison of existing rents and existing ground values in various cities of the United States is being made by the National Association of Real Estate Boards through a questionnaire sent out this week to all member boards. The association is asking boards to state the actual rents being received for property in the best business districts, in secondary business districts, and the like. It is asking at the same time ground values current in these same sections. As a result of this study it expects to make possible a valuable comparison on relationship between rents and ground values over the country.

Freight Car Loadings Drop

Revenue freight loading for the week ended March 10, totaled 951,533 cars, the car service division of the American Railway Association announced recently.

Compared with the preceding week, this was a decrease of 7,934 cars with decreases being reported in the loading of grain and grain products, live stock, forest products and merchandise less than carload lot freight. Increases, however, were reported in the loading of coal, coke, ore and miscellaneous freight.

The total for the week of March 10, was a decrease of 49,201 cars below the same week in 1927, and a decrease of 15,872 cars compared with the corresponding week two years ago.

	1927	1926	1925
Sept. 3	1,117,069	1,143,448	1,102,785
Sept. 10	989,472	1,024,998	975,499
Sept. 17	1,127,613	1,182,641	1,112,009
Sept. 24	1,125,868	1,175,407	1,121,025
Oct. 1	1,126,390	1,180,049	1,113,283
Oct. 8	1,100,552	1,074,928	1,106,036
Oct. 15	1,119,872	1,202,780	1,106,009
Oct. 22	1,128,486	1,200,941	1,120,677
Oct. 29	1,112,621	1,208,878	1,091,154
Nov. 5	1,038,852	1,112,621	1,062,646
Nov. 12	974,862	1,106,889	1,049,940
Nov. 19	968,103	1,071,707	1,057,923
Nov. 26	840,803	937,844	923,206
Dec. 3	918,237	1,054,048	1,023,666
Dec. 10	877,600	992,855	1,008,696
Dec. 17	868,162	944,396	969,738
Dec. 24	829,006	768,940	969,738
Dec. 31	679,600	734,281	701,061
	1928	1927	1926
Jan. 7	754,062	933,940	907,622
Jan. 14	906,734	942,731	931,735
Jan. 21	884,095	936,160	921,643
Jan. 28	902,832	943,879	925,696
Feb. 4	926,204	965,664	914,491
Feb. 11	906,009	962,602	917,625
Feb. 18	887,891	954,794	932,281
Feb. 25	869,590	918,858	912,935
Mar. 3	959,537	989,863	965,009
Mar. 10	951,553	1,000,754	967,425

Grinding Cement

In grinding cement, a liquid which will be evaporated by the heat produced by the grinding is added to the cement during the last stage of the grinding process to keep the temperature of the cement below the temperature at which the cement is inclined to adhere to the surfaces, such as the grinding bodies in the mill. The liquid is supplied to the cement in an atomized condition, and calcium chloride, tannin or other substance it is desired to supply to the cement may be suspended or dissolved in the liquid used for regulating the temperature. The liquid is introduced into the discharge end of the grinding mill. C. Pontoppidan (Denmark) (British Patent 283,091).

Utilizing Waste Lime

Dry calcium hydroxide which has been obtained from calcium carbide by treatment with a small amount of water, is mixed with clay or other siliceous and aluminiferous material to form Portland cement. Wacher Gesell. f. Elektro chemische Industrie (Germany) British Patent 282,458).

RESEARCHES ON CONCRETE MATERIAL*

THIS report follows a similar form to the reports submitted by the Committee in 1926 and 1927 and consists mostly of brief summaries of the replies to questionnaires submitted to 215 testing laboratories in the United States and Canada. It consists of researches on cement, plain concrete, plain aggregate, reinforced concrete; suggested researches on concrete and related subjects; and references to papers and reports published in 1927.

Many of the researches were not completed, but the findings are given in the report to assist in further research work. The investigations of cement included the constitution and properties of Portland cement; development of damp closet for cement testing; volume changes in neat cement pastes; effect of various types of gypsum on the properties of cement; Portland cements in mortars and concretes; effect of quality of Portland cement upon strength of concrete; relation between tensile strength of cement and strength of resulting concrete; and humidity equilibria of hardened cement pastes.

The investigation in relation to aggregates included the influences of iron content on mortar strength; mechanical analysis of sand, application of water cement theory to testing of sand; effect of the character of coarse aggregate in concrete; relation between standard abrasion tests and abrasion on smaller sizes of gravel and on crushed gravels; concrete from unsound stone; use of coarsely ground screenings with sand that does not meet specifications; and study of methods of determining moisture in sand. The tests embodied studies on the relation between shape, size, gradation, surface peculiarities, durability and other properties of aggregates on the workability and strength of the resulting concrete.

Plain Concrete

In plain concrete with reference to admixtures, studies were made on the effect of hydrated lime; atomite as an admixture; effect of diatomaceous earth on strength and other properties; and tests of colors.

With regard to autogenous healing, it was found that healing takes place in both running and stagnant water, but no definite quantitative laws are evident. Rich mixtures heal more readily than lean ones and all water cement ratios heal.

Various methods of curing concrete were studied by the different laboratories, among which were calcium chloride as a curative agent; field curing; and the effect of moist closet temperature on strength of standard cement mortar briquets.

In field tests and controls, proportioning of materials was studied by making beams and cylinders on two paving jobs and cores were taken from road using weight and volumetric proportioning of the aggregates. Principal factors in form of transverse tests for determining the quality of concrete are its cheapness, simple operation, reliability and concordance of results. Transverse tests made on 6 by 6 by 30 inch beams using several methods of loading show that careful attention must be given to methods of applying, to method of supporting beam and to the rate of application of the load.

It appears that the older the concrete, the less rapid the rate of flow; the flow varies with magnitude of the stress, but the variation is not uniform; flow is less for water soaked specimens than for those cured in air; and flow varies with the instantaneous deformation and varies inversely as the modulus of elasticity.

Jigging of 6 by 12 inch concrete cylinder increases compressive strength from 70 to more than 100 per cent. The rate of jigging has no effect upon final strength, but slower rates require a longer period to produce the same results, but rapid jigging produces segregation which, if carried on too long develops smaller increase in strength over unjigged than that developed by shorter periods of rapid jigging. Cellite or clay in small quantities prevents segregation of jigged concrete.

Permeability tests show that no water flows through an 8 inch block under pressure of 150 pounds, if the water ratio is 0.90 with slight leakage with a water ratio of 1.00 and considerable increase for greater water ratios. For the purpose of establishing danger line in cement economy for general foundation concrete, 6 by 12 inch cylinders, some materials, but with varying cement content were placed under head of water and loss of head recorded after 7 and 28 days curing. Results of the tests indicate the possibility of definite conclusions when a sufficient number of tests have been made. Preliminary tests of waterproofing compounds and the permeability of cement show that 2 inch discs of well graded 1:2:4 concrete were watertight under loads of 400 feet. Development of data on the economics of concrete mixtures indicates that the best proportions for any given set of aggregates can be closely approximated in advance, and effect of cost of screening, regrading or other changes can be determined so that their suitability may be judged. Results of investigation showed less variation in strength of concrete proportions by weight than by volume and greater yield for weight proportioning. About 80 per cent of inferior sand and gravel gave satisfactory strengths with cement increased from 5 to 20 per cent depending on the aggregate. Cylinders were

*Abstract of paper presented to the twenty-fourth Annual Convention of the American Concrete Institute.

tested at 1, 2, 3, 4, 7 and 28 days, temperature ranging from 25 to 75 degrees Fahr. and it was found that after four days the concrete had sufficient strength. The mix required 2.25 barrels cement per cubic yard with 3 per cent calcium chloride.

Studies made on the compressive strength of concrete from ¾ inch aggregate, molded in 3 by 6 inch cylinders and 6 by 12 inch cylinders showed at 28 days that the average strength of the 3 by 6 inch cylinders was 2.2 per cent less than that of the 6 by 12 inch cylinders. At earlier ages, the agreement was even closer. The indications are that either wetter consistencies or higher water ratios retard the gain in strength at earlier ages, so that the familiar strength age curve may be concave downward for relatively stiff mixtures, approximately a straight line for medium consistencies and concave upward for wet mixtures. Tests were designed to show the relation between the tensile, flexural and compressive strength of plain concrete and between the modulus of elasticity in tension and compression as affected by size, grading and type of aggregate, quantity of cement and mixing water, age, curing condition and other factors.

In relation to temperature effects, it was found that exposure to freezing was most injurious after casting. Concrete cast and cured at 70 degrees Fahr. is about one-third stronger than that cast and cured at 40 degrees Fahr. Concrete beams were exposed to freezing at different ages and were cured indoors at 40 and 70 degrees Fahr.

About 300 3 by 3 by 40 inch concrete bars with steel contact points in the ends ranging from one month to four years old are now under observation to determine the expansion and contraction, due to changes in moisture conditions. It is observed that oven dried specimens, stored in air of constant humidity and constant temperature, expand and absorb moisture at first and then at a gradually decreasing weight until a state of volumetric weight and equilibrium is reached and the rate of increase in length and weight varies with the degree of humidity; specimens stored in water increase in both length and weight; green and water soaked specimens stored in dry air both shrink and lose weight; oven dried concretes, varying as to richness of mix stored in air at a given humidity have an expansion and an absorption varying directly as the richness of the mix; the shrinkage is greater for rich than lean mixes when water soaked concretes of varying mixes are stored in dry air; and with granitic concretes, the percentage of fines has no appreciable effect upon the magnitude of the shrinkage when the concrete dried nor upon the expansion when it is water soaked.

Researches in the field of reinforced concrete are generally concerned with arches, chimneys, culvert pipe, frames and slabs. Studies are in progress on all lines. The results of the researches on reinforced concrete chimneys was published in 1927. For results of the investigations on culvert pipe, reference is made to bulletins 76, 79 and 80 of the Iowa Engineering Experiment Station.

Among the researches suggested on concrete and related subjects which were compiled from a questionnaire were aggregate for rapid determination of the moisture content of sand and research with reference to fine and coarse aggregate, quality of coarse aggregate, abrasion tests for fine and crushed gravel and effect of surface condition of coarse aggregates on the strength of concrete as revealed by compressive and transverse tests; thorough investigation of admixture in concrete with relation to effect on strength, density, workability, water tightness, etc.; anchorage of footage stools, hooks for bars radius of bend, comparison of measured stresses, with theoretical stresses on upstream and downstream force of an arch dam, restraining effect of lateral ties in columns and study of column splices.

Experimental investigation will be prosecuted to secure data for design of reinforced concrete wall wings which should include a study of external pressure acting on wing walls as well as a study of distribution of internal stresses within the wall.

Analytical investigations with some experimental verification of the value of the flat slab theory; multiple arch bridges and dams, monumental building frame; economic possibilities of rib compensation in arches; local stresses in reinforced at re-entrant angles, openings and other points of discontinuity of loading or shape; deflection of beams and slabs with special reference to determination of moments of inertia and stiffness of coefficients respectively; combination of structural steel shapes and built up members with concrete; investigations on long span slender arches; and mechanical methods of analysis for statistically indeterminate structures.

The report gives a list of reports and papers published in 1927 which include the following subjects relating to cement; construction, fineness of manufacture, general research, temperature effects, methods of testing and tests, time of setting, volume charge and cements other than Portland, relating to plain concrete, admixtures, aggregates, chemical analysis, curing destructive agencies, drain tile, efflorescence, field control, flow underload, impregnated concrete, lightweight concrete, pavements, permeability, pipes, placing concrete, proportions, research, retempering, strength, stucco, temperature effects, volume change, waterproofing, workability; relating reinforced concrete, arches, beams, bond, bridges, chimneys, columns, dams, expansion, piles and piers, pipe, poles, reinforcement, slabs, specifications and wind stresses.

THE FINANCIAL BUDGET AS AN AID TO BETTER MANAGEMENT

By J. J. Berliner

THE idea of budgeting was originally applied to control the financial affairs of states, municipalities and other legislative units. Its application to business world has developed almost entirely since the World War. Although varying in minor details in many individual businesses, the principle underlying the budget system in each case is the same. What a budget control does is to set up a definite goal of attainment, and furnishes a yardstick by which all phases of the business program may be adjusted. In short, budgeting coordinates the plans of several branches of a business—purchasing, production, sales, advertising, and administration. The budget originated to control costs—not only for the business as a whole, but for each department because the concern's budget is merely a total of departmental budgets.

The preparation of estimates for the budget, naturally, leads to a greater standardization of manufacturing processes, and to a more careful consideration of expenses. In addition, the budget also affords a basis for comparison with the trend of business and the various barometers, because it shows whether the concern is progressing according to its own estimates, or whether it is falling behind.

Scope of Budgetary Control

In formulating and applying the budget system, certain things must be kept in mind. In the first place, although the budget is contrived to control, it cannot take the place of management. Its purpose is to guide as much, if not more, than to control. It should serve to give the plant executive, information of value in helping him to make his decisions. It should never act as an inflexible bar against the exercise of his own judgment, because by so doing, it would destroy individual initiative, and turn the business into a mechanical operation.

Budget Procedure

The general procedure in preparing the budget is similar in almost every case, although the details may vary widely.

1.—Estimates are prepared of the operations of

Fig. 3 ANALYTIC CASH ESTIMATE - stands for deductions.

ITEMS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	NET EFFECT OF CHANGES ON CASH
NET INCOME	$ 4,100	$ 4,000	$ 4,300	$ 4,900	$ 6,500	$12,000	$ 35,800
NOTES REC.	- 1,000	2,000	- 2,000	- 2,000		4,000	1,000
ACCOUNTS REC.	25,000	25,000	25,000	25,000	25,000	25.000	150,000
INVENTORY							
RAW MATERIAL				10,000			-10,000
FINISHED GOODS					10,000	5,000	- 5,000
BUILDING			-10,000	- 2,000			-12,000
MACH. & EQUIP.			-20,000	- 1,000			-21,000
FURNITURE			- 2.000				- 2,000
NOTES PAYABLE		-20,000	10,000			-10,000	-20,000
ACCOUNTS "	-10,000	-10,000		10,000		-10,000	-20,000
SURPLUS						-50,000	-50,000
NET CHANGES	$18,000	$ 1,000	$ 5,300	$24,900	$21,500	$24,000	$46,800
CASH ON HAND-1st of MONTH	50,000	68,100	69,100	74,400	99,300	120,800	
ESTIMATED CASH CLOSE OF MONTH	68,100	$69,100	$74,400	$99,300	$120,800	$96,800	
CASH ON HAND 1st.of PERIOD							$50,000
ESTIMATED CASH ON HAND AT CLOSE OF PERIOD							$ 96,800

MASTER BUDGET

DATE

CLASSIFICATION	BUDGET ALLOWANCE 1927	EXPENSES 1927	BALANCE 1927	BUDGET BALANCE 1/1/1927
SALES				
RETURNS AND ALLOWANCES				
NET SALES				
PURCHASES				
ADMINISTRATIVE				
ADVERTISING				
SELLING				
SHIPPING				
TOTAL				
FACTORY ADMINISTRATION				
FACTORY BUILDING				
DIRECT LABOR				
MANUFACTURING OVERHEAD				
TOTAL MANUFACTURING				
PURCHASING EXPENSE				
TOTAL EXPENSE				

FIG 1 MASTER BUDGET

each separate department of the business for the budgetary period. Each department will have its own form of budget, depending on the nature of its operations. Purely service departments, such as personal, credit, and office management will merely present estimates of expenditures.

2. The second step in preparing the budget is the examination and coordination of the various departmental budgets. This is done by some specified official of the concern. Estimated receipts are compared with estimated expenditures. If the estimates show that expenditures will exceed receipts, it will be necessary to cut down departmental budgets, or to provide additional capital.

When the expenditures have to be cut down, great care must be taken to see that revenues are not reduced as well. For example, if the costs of the production department are cut down, it may not be able to produce so much or of an equal quality.

If advertising is reduced, then sales may show a falling off also. Under certain conditions, it may be inadvisable to cut down the expenses. In such cases, the only remedy is to find additional capital to repair the deficiencies in income.

It is customary to call the head of the department into consultation when the budget which he has prepared seems to be out of line in any way. At such a time, he has an opportunity to justify his position, and show why he has set his estimates as he has done.

3. When the final budget is completed, it will call for a certain quantity of production from the production department, and of sales from the sales department, which cannot be exceeded without permission from the official in charge of the budget. When the budget has been set, it is customary for the head of each department to make a budget of operations for his own use, so that he can achieve the set minimum without exceeding the stipulated expenses. If, for example, the advertising department desires to exceed its set quota, it must make formal application. If sales seem to warrant additional expenditures, then permission may be given, and the budget altered accordingly.

4. As soon as the budget is in operation, each department sends reports to the budget official at stated intervals which show how estimates compare with actual performances. If this is not done carefully and regularly, the value of the budget is without value.

Master Budget

The following, figure 1, is a Master Budget Sheet. This budget sheet shows the yearly performances of all the plants, if there are more than one, purchases, sales, selling, administrative expenses, etc. Separate budget sheets made out for each one of the departments. Budget allowances are made out in conference between the departments. Budget allowances are made out in conference between the department head, and the budget official or committee every 12 months. No changes are allowed in the budget allowance, a corresponding excess is allowed in purchases and factory expense.

Financial Budgeting

In the final analysis, the prosperity, and even the existence of any business enterprise, is dependent upon its ability to make money. The financial planning of a concern which always has cash in hand to meet all its demands is, of course, relatively simple, but the majority of concerns do not fall under this heading. Thus, in the trades at seasonal times, there is a demand for additional funds during the period of greatest activity, such loans to be paid off later as the goods are settled for.

Function of Financial Executive

The budget lays the foundation of the financial road along which the treasurer of the company (or the owner in a small concern) must take his way. It will tell him the following things:

1. How much money is to be spent.
2. What reserves must be kept for taxes and other fixed charges.
3. What gross and net profits should be, all things being considered.
4. What new developments are under consideration. The treasurer (or owner) of concern may find that plans call for more money than is on hand or will be on hand. For example, the production department has a new product which it wishes to manufacture. It plans to put out 50,000

units a year, requiring new machinery, more space, more labor, etc. The treasurer (or owner) will have to decide how this money shall be raised.

The Financial Budget

The financial budget provides estimates of cash receipts and disbursements. It covers no standard period, but may vary from one month to one year, depending on the individual concern's requirement. In reality, the financial budget is a combination of two budgets; one for income and one for outgo. Cash is figured from cash sales, accounts receivable and from cash deposits received on containers, etc., during the budget period.

Disbursements will include accounts payable, maturing notes, operating costs during budgetary period, salaries and wages, cost of materials, all fixed charges, etc.

The following is a budget of an estimated operating statement:

Budget Estimated Operating Statement (1927)

		Per Cent of total
Net Sales:		
Class A	$ 8,000,000	80.0
Class B	800,000	8.0
Class C	1,000,000	10.0
Class D	200,000	2.0
	$10,000,000	100.0
Production Costs:		
Class A	$ 4,800,000	60.0
Class B	560,000	70.0
Class C	650,000	65.0
Class D	160,000	80.0
Total	$ 6,170,000	61.7
Gross Margin	3,830,000	38.3
Selling:		Per Cent
Sales Administration	$ 200,000	2.0
Gen. Sales Dept. Expense.	50,000	0.5
Special Promotion, etc.	50,000	0.5
District Operating Expense	1,600,000	16.0
Advertising A	400,000	4.0
Advertising B	50,000	0.5
Advertising C	100,000	1.0
Total	$ 2,450,000	24.5
Net Margin	1,380,000	13.8

All figures given are, of course, hypothetical and used for purposes of illustration.

It is desired to know what the estimated net profits of the business are to be. The following table shows how net profit may be estimated from operations for the month.

Estimated Operations, October, 1927

Product Sales	140—Product A 120—Product B 270—Product C 250—Product D 200—Product E	$.....
Sundry Sales		$.....
Total Net Sales		$.....
Less Cost of Sales		$.....
Gross Profit		$.....
Manufacturing Division Expenses	$.....	$.....
Indirect Factory Departments	$.....	
Less Overhead Absorbed by Production	$.....	
Less Overhead Deferred	$.....	
Overhead Unabsorbed (or overabsorbed)	$.....	$.....
Selling and Administrative Expenses		$.....
Total Expenses to be Deducted from Estimated Gross Profit		$.....
Estimated Net Profit for October		$.....

TREASURER'S BUDGET

CASH ESTIMATE — MONTH OF JAN 1928

	DOLLARS	
	ESTIMATED	ACTUAL
BALANCE BEGINNING		
RECEIVABLES		
INCOME FROM INVESTMENTS		
NOTES		
TOTAL		
DISBURSEMENTS		
PAYROLL		
ACCOUNTS PAYABLE		
EXPENSES		
ACCRUALS, COMMISSIONS		
DEFERRED CHARGES		
INSURANCE		
INTEREST ON BANK LOANS		
NOTES PAYABLE		
MISC.		
TOTAL		

FIG 2 TREASURER'S BUDGET

Various reports are used for making up the budget. For illustration the following items should be considered:

1. Daily reports of customers' orders received.
2. Daily report of shipments made, compared with quota set for sales division.
3. Daily factory production.
4. Schedules and lists of employees from which payroll may be computed.

Estimates of sales for the coming month are secured from the order department of the sales division, giving the kind and number of each product to be shipped, and from this the gross profit can be calculated. By subtracting the estimated expenses, the net profits are obtained. The following is an illustration of the estimated expenses:

The total payroll (theoretically figured) for October can be approximately computed as follows:

Manufacturing Division	500 Employes	$ 56,000
Indirect Factory Division	250 Employes	28,000
Selling and Administrative	150 Employes	18,000
Total	900	$102,000

Condensed Estimate of October Cash Requirements

Cash, as per above budget	$.....
Liability incurred in September payable October	$.....
Total	$.....
To apply against this estimate of requirements:	
Estimated bank balance Sept. 30	$.....
Estimated bank receipts for October	$.....
Total	$.....
October cash requirements	$.....
Estimated bank balance Oct. 31	$.....

While the principle of the cash budget is simply a statement of estimated receipts and disburse-

ments, the requirements of the individual concern will necessitate certain adjustments. The following treasurer's budget, Figure 2, shows one of the simplest forms.

The analytic cash analysis is an effective means of forecasting cash requirements. It is particularly important to know cash requirements. Figure 3 is an excellent illustration of an analytic cash estimate of a manufacturing company. The following is an explanation of the items in Figure 3:

Line 1. Here appear the monthly estimate of net profits which are equivalent to additions to cash.

Line 2. In January—It is expected that notes receivable will increase by the amount of $1,000. This is indicated as a deduction from cash. In February, the notes appearing in the balance sheet of June 30 falls due, and are considered collectable. This means an addition to cash. In both March and April it is expected that notes receivable will increase by the amount of $2,000. In June no change is anticipated, but in July they are expected to decrease by $4,000.

Line 3. The largest debtor of the firm, whose financial responsibility was and is unquestionable, is expected to liquidate his account at the rate of $25,000 per month. This is in accordance with the agreement under which the original credit was extended. Except for this, no material change is anticipated in accounts receivable.

Line 4. The stock of raw material on hand is to be increased in April by $10,000. The company will allow 60 days in which to pay for the material, and hence the compensating change during the same month in bills payable, as shown in Line 10.

Line 5. The closing inventory of finished goods May 31 is expected to increase by the amount of $10,000 which tends to cause a deduction from cash for the same discount. In June, however, the same inventory will decrease $5,000, with a corresponding addition to cash.

Lines 6 and 7. The executive committee has decided to enlarge the plant capacity during February and March by the addition of an auxiliary plant. Construction estimates have been made and the orders for the equipment placed. The total cost is to be $33,000, of which $30,000 will be incurred in February, and the balance in March.

Line 8. Additional furniture costing $2,000 is to be purchased in February.

Line 9. A note payable in the sum of $20,000 falls due during January and will be paid. The construction company erecting the addition to the plant has agreed to accept in February a note in amount of $10,000, payable in June.

Line 10. It is anticipated that accounts payable will be reduced by $10,000 during January, and by a like sum in February. The purchase of additional raw material in April will increase accounts payable $10,000; the account will be paid, according to agreement, during June.

Line 11. A cash dividend is to be paid during June in amount of $50,000, which will reduce surplus by that sum.

The remaining lines of the analytic estimate are self-explanatory. Inter-relation and interdependence of departmental activities that budgetary control is necessary. It is difficult to consider the activities of any one department without considering to some extent their effect on the activities of all the other departments, and vice versa. In the formulation of the plans of any one department for the ensuing budget period, it is necessary to consider at every stage of their development, their effect upon the plans, of every other department. Modifications and revisions are often necessary in order to effect coordination.

Revise Uniform Mechanics' Lien Act

Announcement is made by the Department of Commerce that the Committee appointed some time ago by Secretary Herbert Hoover to study the Mechanics' Lien Laws of the various states for the purpose of determining whether the subject is susceptible of uniform legislation has completed the second tentative draft of a uniform act.

Mechanics' lien acts are in force in all states of the union. They are for the purpose of protecting the claims of contractors, subcontractors, materialmen, laborers, and others who contribute to an improvement by constituting the property improved a security for their claims while at the same time protecting the owner from payment of claims which, as to him, would be unjust. Complaints have been made that some existing laws are inequitable and that lack of uniformity causes unnecessary expense and inconvenience to those who do an interstate business and to laborers who move from state to state. At the request of various groups this advisory committee was appointed.

The committee is composed of representatives of the principal groups engaged in the construction industry. The National Conference of Commissioners on Uniform State Laws, which is interested in all questions of uniform state legislation and which is composed of officially appointed delegates from each state also has a committee studying this subject and working in close co-operation with the Department Committee.

The first tentative draft of a Uniform Mechanics' Lien Act was published in the fall of 1926 and distributed to individuals and organizations known to be interested in the subject, soliciting their suggestions and criticisms. A considerable response resulted from this solicitation and in the light of these suggestions which have been carefully analyzed by the committee, the second tentative draft has been prepared.

SETTING AND HARDENING PROCESSES IN CEMENT

By Dr. R. Nacken

STARTING this article the author discusses first the use of the X-ray in carrying out investigations on cements. The nature of the testing apparatus and general details regarding its use are given. The interpretation of results is also part of the first section of this rather long article and we are very briefly reviewing this portion in order to save space. The author finally tells of

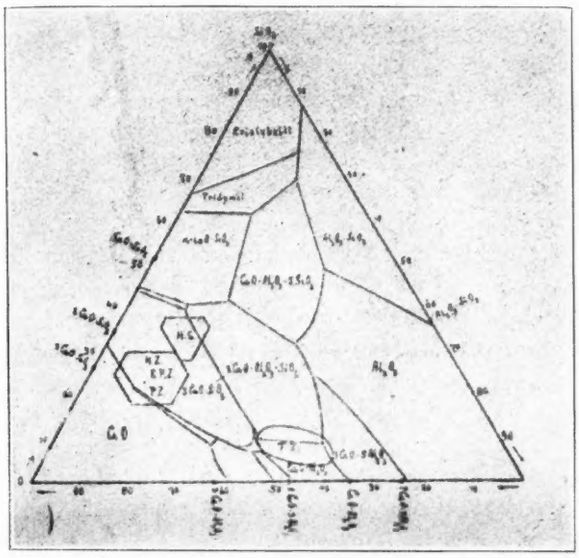


Figure 1.

certain studies that he made along these lines on the composition and constitution of cement and of the new experiments that he recently instituted and that are reported here, dealing with the application of these methods to the setting and hardening of cement.—Editor.

The setting and hardening of cement are the two most important phenomena that the cement man has to deal with. It has been found in recent years that a series of mixtures are characteristic of cements and that the typical cement property has not been closely bound to the cement field itself, but that mixtures of the system, lime, silica and alumina, in other proportions also yield technically valuable cements. These relations are shown in graphical form in figure 1. It is noteworthy that the crystallization endpoint in the cast of Portland cement as well as in molten cement containing large amounts of alumina lies at the same point. Hence it follows that the same compounds must be present in these products but only in different proportions.

The author has accordingly carried out certain experiments with two kinds of cement. One was a normal Portland cement and the other a cement rich in alumina and melting at a temperature of 1600 degrees C. The analysis of the aluminous cement is as follows: Silica 9.6 per cent, alumina 38.55 per cent, iron oxide 7.25 per cent, titanium dioxide 2.10 per cent, lime 41.46 per cent, sulphur 0.2 per cent and loss on ignition 0.2 per cent, making a total of 99.36 per cent.

The more the author considered the problem of setting and hardening of cement, the more it appeared to him that colloid-chemical processes are involved in these phenomena. The many different processes which take place during the manifestation of these phenomena are best explained in this manner. At any rate this will serve as a basis in these investigations.

It is always advisable to try to find an analogy between phenomena that are being investigated and some process that takes place in Nature. In this particular case the phenomena which take place in the setting and hardening of cement are seen to play a very important role in the formation of natural stone masses. The author has called this phenomenon diagensis. It was therefore thought advisable to examine certain natural stones that were made by sedimentation, such as sandstones and the like, which appeared to be com-

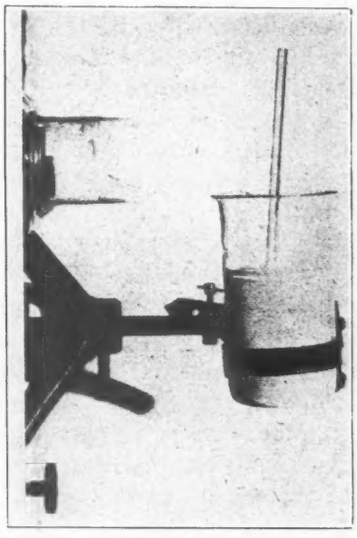


Figure 2.

posed of more or less fine particles of sand, broken bits of stone and the like, which are bound together by means of a binding agent. Certain stones were examined in which the binding agent was iron hydroxide and others in which calcite was the bound.

In examining these stones and conjecturing as to the time it took for them to harden, we make

use of geologic conceptions of time. Examination of the binding agent, the cementing agent as it may be called, in polarized light showed that it was of limey character at the start and that it had then been converted into the crystalline condition after a long time had elapsed. This fact may be better stated in that in the original state was of one high dispersion which was afterwards con-

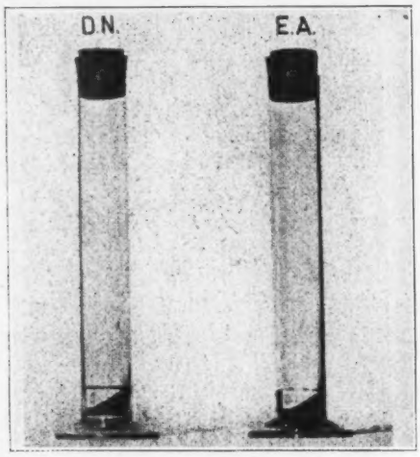


Figure 3.

verted into coarse disseminations. It is clear that colloid chemical principles are concerned in these transformations, and that the process of hardening cannot be considered as being of a purely molecular chemical character. The phenomenon depends rather on certain forces which are dependant on the distribution of the particles of matter, that is on the special surface area of the substance.

A solid substance, whether it is crystalline or amorphous, is characterized by the fact that, just like a liquid, the sphere of influence of its molecules or atoms is distributed over a limiting surface. The influence of valency is manifested at these surfaces. If a substance is found in which the liquid portion becomes solid on gradual evaporation, then it makes no difference whether it is crystalline or amorphous. This substance will seek on its own part to combine its surface valency with that of the binding agent. Glue or gelatin is an example of such a substance.

The following conclusions can be reached, referring to conditions that must be fulfilled, if a solid, firm combination is to take place between the individual particles, necessary to the proper hardening of the cement, for example.

In the first place the gas which is absorbed at the surface of the material must be removed. Then the substance that acts as the binding agent must gradually become hard and it must be free from cracks in the hardened state. In the third place the precipitation of this binder or rather its formation in active state must not take place rapidly and then again it must not take too long for the hardened condition to appear. In the fourth place the separated or precipitated binding agent, that the substance is thrown out of solution or suspension by the evaporation of the water, must be as finely dispersed as possible in order that it present the largest possible surface area for carrying out its functions. Finally the solvent must either be removed or combined with the solid matter.

In the case of glue or gelatin the binding action is effected by the evaporation of the water and the precipitation of the solid glue substance. An amorphous binding agent is thus formed. On the other hand in the case of gypsum the water is removed by entering into combination with the solid substance and fine crystalline needles are thus formed. We have both phenomena, as we shall see in the case of cement.

It is advisable to define the important properties of a colloidal system before attempting to go into further discussion of this subject. Colloidal systems are dispersive systems in which surface forces exert a great influence. As is known the colloidal system consists of the fine dispersion of one substance in another. Suspensions are solid substances existing in liquids and emulsions are liquid substances existing in other liquids. The total surface area of the dispersed or emulsified substance is its most important property.

A small decrease in the size of the individual particles causes a very great increase in the total surface area of all the particles. Furthermore colloidal transformations infer conversion of size of particles from coarse to fine and vice versa. The finest dispersion are of course solutions and the coarsest suspensions such as sand in water. Between the two we have the colloids that are characterized by special properties, such as ab-

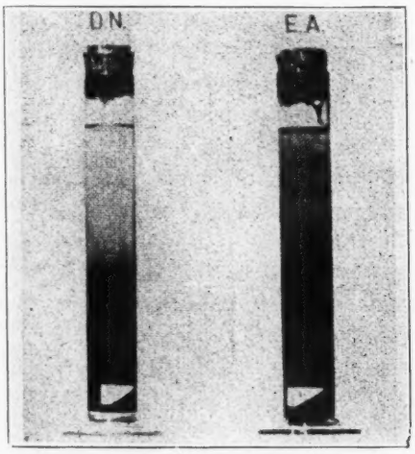


Figure 4.

sorption of substances, coloring power, a very characteristic luster, opalescence and the like. The finest suspensions can be resolved into their component part by examination under a microscope, but colloidal solutions must be examined under the ultramicroscope as the individual particles are not recognizable under the ordinary microscope.

Both silicic acid and alumina are examples of

materials in which these characteristics can be traced. Water glass is for example a solution of alkali silicate in water. It has a slight opalescence which indicates its colloidal character. Silicic acid flakes are also a well known substance, and here again we have a dispersive system. But in this case the finely divided medium is water while in the former case it is silicic acid. The flakes are

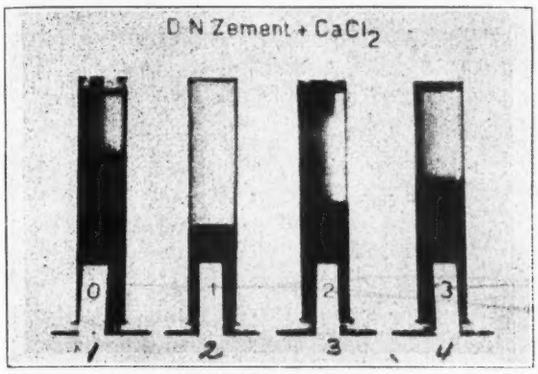


Figure 5.

a sort of spongy mass, the silicic acid having this sort of a structure. The framework of the structure is silica intercalated with water, located in hollow spaces which are of very fine diameter. However these very fine spaces or channels would form many miles when placed end to end. When the solvent is present the colloid is called a sol and when it is absent it is called a gel.

Sols are converted into gels. It may be interesting to describe a very nice experiment which clearly exemplifies this transformation. A water glass solution is mixed with a solution of aluminum acetate and enough acid is added to keep the mixed solutions neutral. The sol character of the solution is ascertained by its opalescence. The contents of the breaker remain liquid but the solution appears to be more viscous than water. If the mixed solutions are allowed to remain for some time, then the mass will gradually coagulate and be finally converted into a jelly-like solid substance, the time of transformation depending on the composition of the mixture. Figure 2 shows just how solid this mass can be. The glass rod is seen sticking fast to the mixture in the beaker. The more water is vaporized from the mass, the stiffer the jelly becomes.

This process is of considerable importance in the setting of cement.

Another experiment is also of great interest and importance to the cement man. In this case a water glass solution of definite concentration is employed. A crystal of iron chloride or calcium chloride is dropped into this solution. The silicic acid gel immediately starts to form and gradually builds up in strange shapes on the crystal of foreign matter. The exact character of this information is rather complicated.

It should also be mentioned in passing that each individual particle of a colloidal solution carries an electric charge. The magnitude of this charge depends on the substance and on the medium in which it is dispersed.

The character of the electric charge varies, that it is either positive or negative. Thus in the experiment with water glass and aluminum acetate, the charge on the silica particles is minus while that on the alumina particles is plus. Inasmuch as opposite charges attract, a reaction takes place and aluminum silicate is formed. The proportions of the silica and of the alumina in the aluminum silicate will vary in accordance with the electrical condition of the particles. Hence it is evident that a straight chemical union does not take place in this case at all, but rather a substance is formed of variable constitution.

This is then the character of the coagulation which takes place in the above experiment. The result is an admirable binding agent. As the water is gradually removed from this substance, it becomes harder and is finally converted into a solid substance which can be cut and pulverized. In the course of time certain recrystallizations take place which make the product even harder.

If the colloidal solution contains salts, that is electrolytes which split into positive metal ions and negative acid ions on solution in water, then these ions may coagulate the dispersive systems. A coarsely dispersed gel is obtained from such sols, and the structure of these gels is materially altered by the action of the electrolytes, even at the time that they are precipitated.

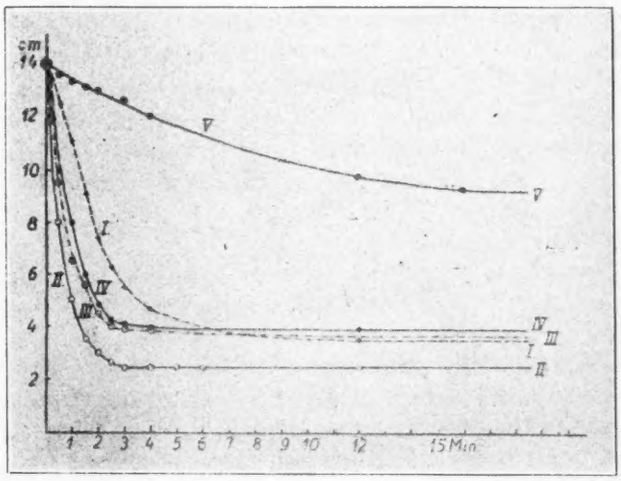


Figure 6.

The situation is just the opposite in the case of flocculated substances. In this instance the medium of dispersion is silica or aluminum hydroxide and the finely dispersed substance is water. The analogy between this and the aforedescribed case is however retained.

Cementing properties are apparently possessed by all substances which have the power of yielding colloidal phases, whether they are structurally

composed of crystalloids or amorphous substances. Gypsum itself or lime have such properties. In the case of gypsum these properties are soon entirely lost, for the reason that the hardening of gypsum depends on the precipitation of crystalline needles. In the slacking of lime, the small lime particles are split apart and a film of water is built up around them, so that various hydrates are formed in addition to the common hydrate which contains just one molecule of water in combined form. The substances, which are composed of silicic acid and aluminum, also possess cementing properties and in their decomposition both colloidal precipitates as well as new crystalloid compounds are formed.

Two ways were open in investigating the reactions that play a part in these phenomena. One was to investigate the mechanism of the processes that take place directly in the cement and the other was to vary the conditions under exact control. Both were used by the author.

If water is added to cement, then the decomposition proceeds spontaneously with the development of heat. This thermal character of the process is of course due to the combination between lime and water to form lime hydrate. If the compound which is being decomposed is quite stable, as for example dicalcium silicate, with its high fusion temperature of 2,130 degrees C., then the thermal character of the process, which corresponds to the formation of lime hydrate, becomes considerably marked in this case, in order to diminish the heat of decomposition of calcium silicate. In the case of molten cements (ciment fondu), in which the calcium aluminate plays an important role, the heating effect is much stronger in spite of the lower lime content.

The first stage of the action of water must be considered to be the formation of a skin of silicic gel around each particle of clinker due to hydrolytic splitting. This silicic gel is more a colloidal sol than a gel.

A simple experiment is very informative along these lines. Figures 3 and 4 show cylinders filled in one case with ordinary Portland cement, marked DN, and in the other case with aluminous cement, marked EA. Ten grams of each cement were used in the experiments. Eighty cubic centimeters of water were added in each case. The fact that a colloidal phase forms immediately can be seen when the cement suspension is allowed to settle. The normal Portland cement settled within a period of approximately three minutes and the aluminous cement required about twice the time. While the liquid over the Portland cement remained turbid, that over the aluminous cement was clear. The fineness of the grinding of the Portland cement was much greater than that of the aluminous cement. Vigorous shaking results in the suspensions becoming more coarsely flocculated and the deposited mass always becomes more voluminous.

The shaking has a very marked effect on the aluminuous cement. While the volume of deposited Portland cement slowly increases, a strongly hydrated mass of aluminous cement is obtained. On the other hand the rate at which the cement deposit varies just in the reverse manner. The aluminous cement settles quite considerably faster and more completely. The coagulation is remarked to be very strongly affected by the lime salts in solution. After repeated shaking of the cement 180.05 milligrams of alumina and 115.25 milligrams of lime are found in the solution over the cement, which means almost 0.3 gram of residue in seventy cubic centimeters of solution. Hexagonal crystallites are formed on the walls of the cylinders after a certain time has elapsed. Microscopic analysis indicates that these deposits consist of calcium aluminate with water of combination. Rosette-like clusters of hexagonal plates form on samples of cement set in water.

There is at this point a gap of wide dimensions in the investigation of cement. Just as frequently as the structure of set clinker has been examined under the microscope, just as infrequently has anyone tried to determine the exact chemical character of these products. The sole investigator which has concerned himself with this matter was W. H. Le Chatelier. These investigations were however made a long time ago and do not stand up against criticism. Le Chatelier speaks of a monocalcium silicate, with 2.5 molecules of water and of the existence of $4CaO.Al_2O_3$ with twelve molecules of water. Only systematic investigations can yield desirable results. These investigations have been in progress for some length of time and in spite of many difficulties they should finally succeed. In the first place the author wishes to state that he may consider the compound 3:1. $CaO.Al_2O_3$ stable and also the compound in which the ratio of the lime to alumina is 2 to 1.

The experiments which were described above were then varied by the addition of electrolytes in order to study their effect on cement suspensions. Only a few of the results obtained will be described here.

Figure 5 shows how the coagulation was effected by the addition of different proportions of calcium chloride. In the cylinder, marked 1, only normal Portland cement was placed. The same cement is found in cylinder number 2 with the addition of half a gram of calcium chloride. One gram of the salt was added in the third cylinder and 1.5 grams in the fourth cylinder. In each case ten grams of cement were mixed with eighty cubic centimeters of water. At the moment that the photograph was taken the pure cement had settled only a little and the same is true of the cement sample in cylinder number 3 while the most set-

tling was obtained in cylinder number 1. Cylinder number 2 shows moderate deposition. Aluminum chloride has an extraordinary powerful action. This fact can be ascertained from the following tabulation and also from the curve sheet on which the tabulated results have been plotted graphically.

Minutes	I	II	III	IV	V
0.0	14.0 cm.	14.0 cm.	14.0 cm.	14.0 cm.	14.0 cm.
0.5	12.0	8.0	9.5	10.0	13.5
1.0	11.0	5.0	7.5	8.0	13.3
1.5	9.0	3.5	5.7	6.0	13.2
2.0	7.4	3.3	4.5	4.7	13.0
2.5	6.2	2.6	4.0	4.2	12.8
3.0	5.6	2.6	3.9	4.2	12.6
4.0	4.7	2.5	3.8	3.9	12.0
12.0	3.5	2.5	3.6	3.8	9.8
30.0	3.4	2.5	3.6	3.7	9.4
15.0 hrs.	3.4	2.5	3.6	3.7	9.4
30.0 hrs.	3.4	2.5	3.6	3.6	9.4

This tabulation and the accompanying curve, figure 6, clearly indicate how the cement is affected. Thus the effect of calcium chloride is very nicely shown. Half a gram of the salt has a strong coagulating effect, and the influence of the disposed chlorine ion predominates in higher concentrations. The hydrochloric acid, which results in the solution of aluminum chloride, is a particularly active agent.

In addition to the experiments, which have been described and which are of an indirect character as far as the mechanism of the setting process is concerned, the author also made a number of direct experiments along these lines. He based these experiments on the assumption that the progress of hardening in set cement can be determined and followed through when the amount of water contained in the cement at various times during hardening is determined.

Analysis of cement at least a year old gave a water content of approximately 21 per cent. If 30 grams of water are used in mixing 100 grams of cement, then the percentage of water in the original mixture is 23 per cent. This, therefore, means that almost all the water that was originally in the cement still remained in it. However, this water has been distributed throughout the cement mass. Thus there is water of hydration, water combined as in the case of zeolite or water contained in the colloidal gel. Only a small portion of the water, 2 per cent, is removed by moderate heating at a temperature of 110 degrees C. A certain cement was examined by the author, who did not know its age, and it was found to evolve only 1 per cent water under these conditions. It was only when the cement was heated to a red heat that the remainder of the water was evaporated.

It, therefore, appeared advantageous to determine the relation between the water loss and time. Cement mixtures were accordingly prepared with 23 per cent water and then set aside and tested from time to time.

Heating curves were then determined with these samples. As is shown in figure 7, a special heating curve is obtained for each type of water combination. The bend in the curves directly after setting is sharpest at 100 degrees C. and decreases with the age of the cement.

The results which are given in the following tabulation were obtained with half gram samples of cements which were heated at various periods after setting. The heating was effected at a temperature of 110 degrees C.

Time after setting	Portland cement	Aluminous cement
5 min.	22.36	23.00
10 min.	20.32	22.84
15 min.	21.93	22.71
20 min.	21.69	22.42
30 min.	21.75	21.85
40 min.	20.56	21.41
50 min.	22.73	21.21
1 hour	20.35	20.55
2 hours	19.16	19.60
3 hours	19.40	19.37
4 hours	18.63	19.27
5 hours	18.21	18.75
6 hours	19.12	18.64
7 hours	20.08	18.50
8 hours	20.61	17.84
9 hours	20.29	17.19
10 hours	20.50	16.34
12 hours	20.43	14.34
1 day	13.00	11.00
3 days	10.70	10.80
4 days	10.40	10.60
1 year	1.63	.....

One thing that is very clear from these results is that the Portland cement does not behave regularly as far as the water content is concerned,

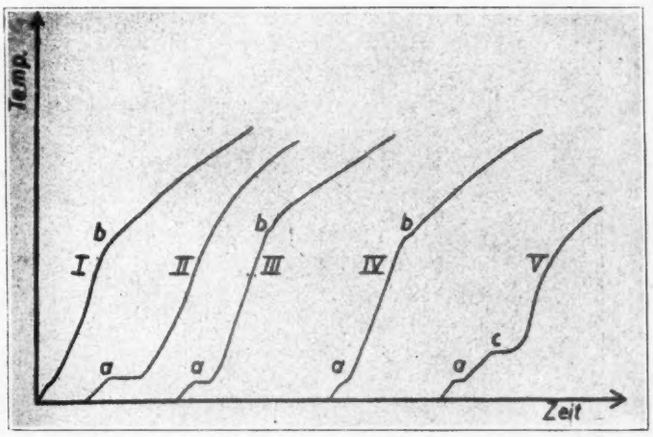


Figure 7

while the aluminous cement behaves very regularly. This is due to the fact that it is somewhat more difficult to make a homogeneous mixture with Portland cement and water than with aluminous cement and water.

The fact that the reaction reached a state of equilibrium in both types of cement within a period of approximately one hour, can be explained in that considerable separation of gel takes place after the water has been combined in the form of hydrates. This hinders further reaction of the clinker with water until the film is burst open. Then the water can again react with the combined clinker particles. This reaction must be quite vigorous at the outset, for the reason that the loss in water is reduced to almost half.

SPEED REDUCERS

Use and Application in the Pit and Quarry Industries

By H. W. Munday

Part Four

DURING the past three issues we have presented three parts of this article on speed reducers. This part completes our article.

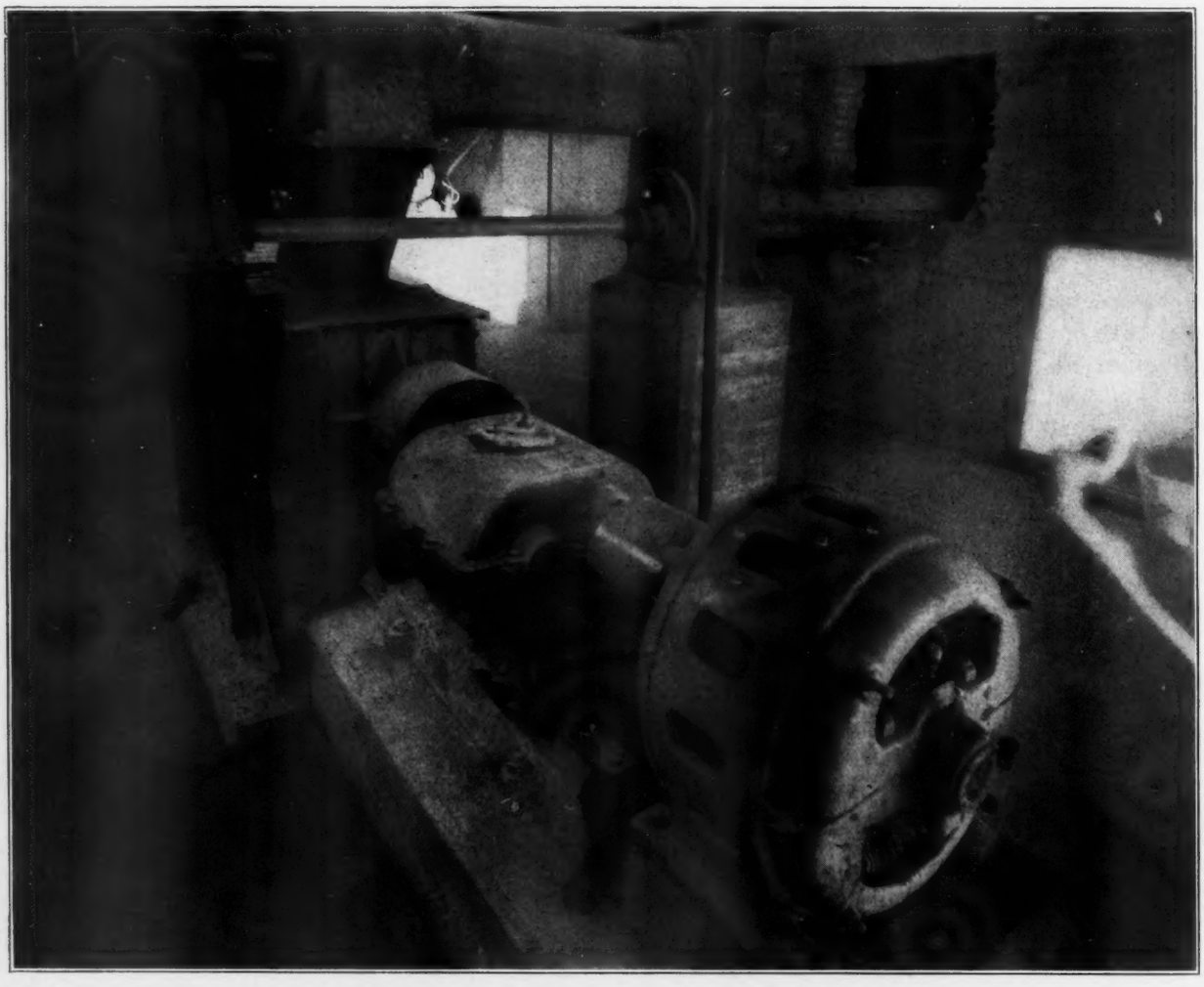
Part one appeared in the February 15th issue and discussed the different types of units including spur gear, worm gear, compound or mill type, herringbone and variable transmission types of speed reducers.

Part two presented some actual installation data and the particular units of Stephens Adamson Manufacturing Company, W. A. Jones Foundry and Machine Company, D. O. James Manufacturing Company, Falk Corporation, Huron Industries, Link Belt and H. W. Caldwell and Sons Company.

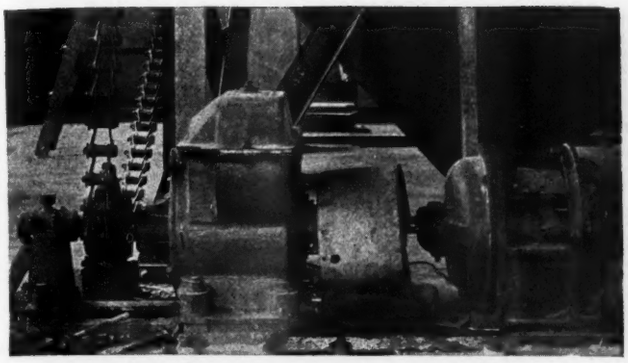
Part three discussed the particular units of the De Laval Steam Turbine Company, Foote Bros. Gear and Machine Company, Horsburgh and Scott, Albaugh Dover Company, Fawcus Machine Company, R. D. Nuttall Company, Palmer Bee Company, William Ganschow Company, Cleveland Worm and Gear Company and Hill Clutch Machine and Foundry Company.

Each part of this article has been illustrated with the different types of units both as manufactured and as installed in plants in the pit and quarry industries.—Editor.

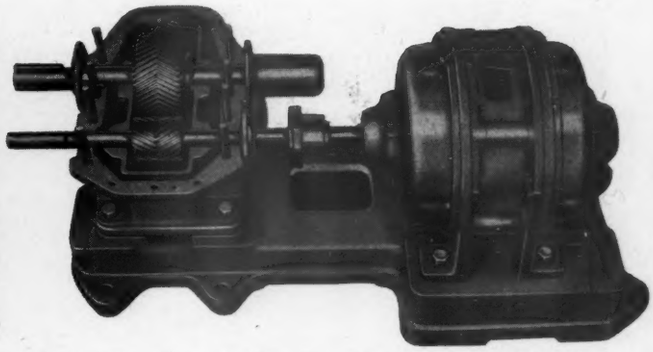
Speed reducers have a wide range of application in the pit and quarry industries. They are used in driving conveyors of all types, elevators, screens, crushers, pulverizers, feeders, agitators, coolers, kilns, hydrators, tube mills, air compressors, bagging machinery, dryers, etc. The question of the installation of speed reducers should be considered largely from the standpoint of economy and this economy should concern savings in power and space. The general improvement in efficiency and reduction in accident hazards are natural consequences from the installation of speed reducers.



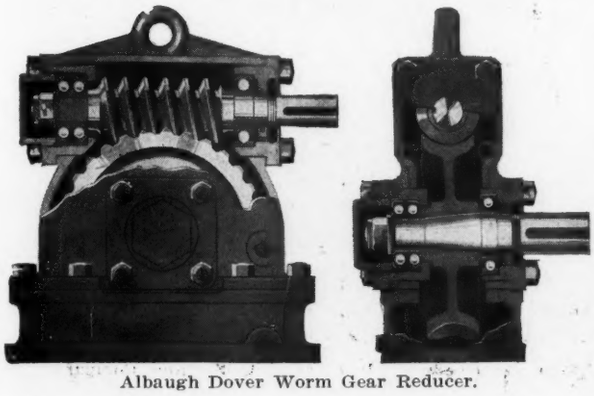
Huron Mill Type Reducer Driving A Screw Conveyor.



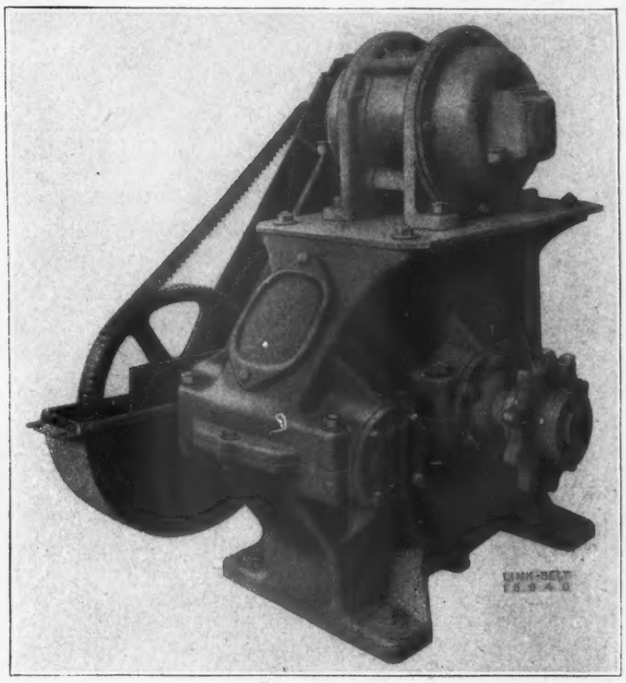
Hill Reducer in a Cement Plant.



A Falk Single Reduction Herringbone Gear Reducer



Albaugh Dover Worm Gear Reducer.



A Caldwell Speed Reducer With Casting Removed to Show Silent Chain Drive

In the actual selection of a particular type of speed reducer unit there are many factors to study. The principal ones are efficiency rating, overload capacity, simplicity of construction, accessibility, adaptability, quietness, compactness, bearings, gears and shafts, housing and lubrication system. These factors have to do with the design of a particular unit. The conditions under which the speed reducer is to operate should be studied and the factors in the construction of the speed reducer analyzed in light of these conditions.

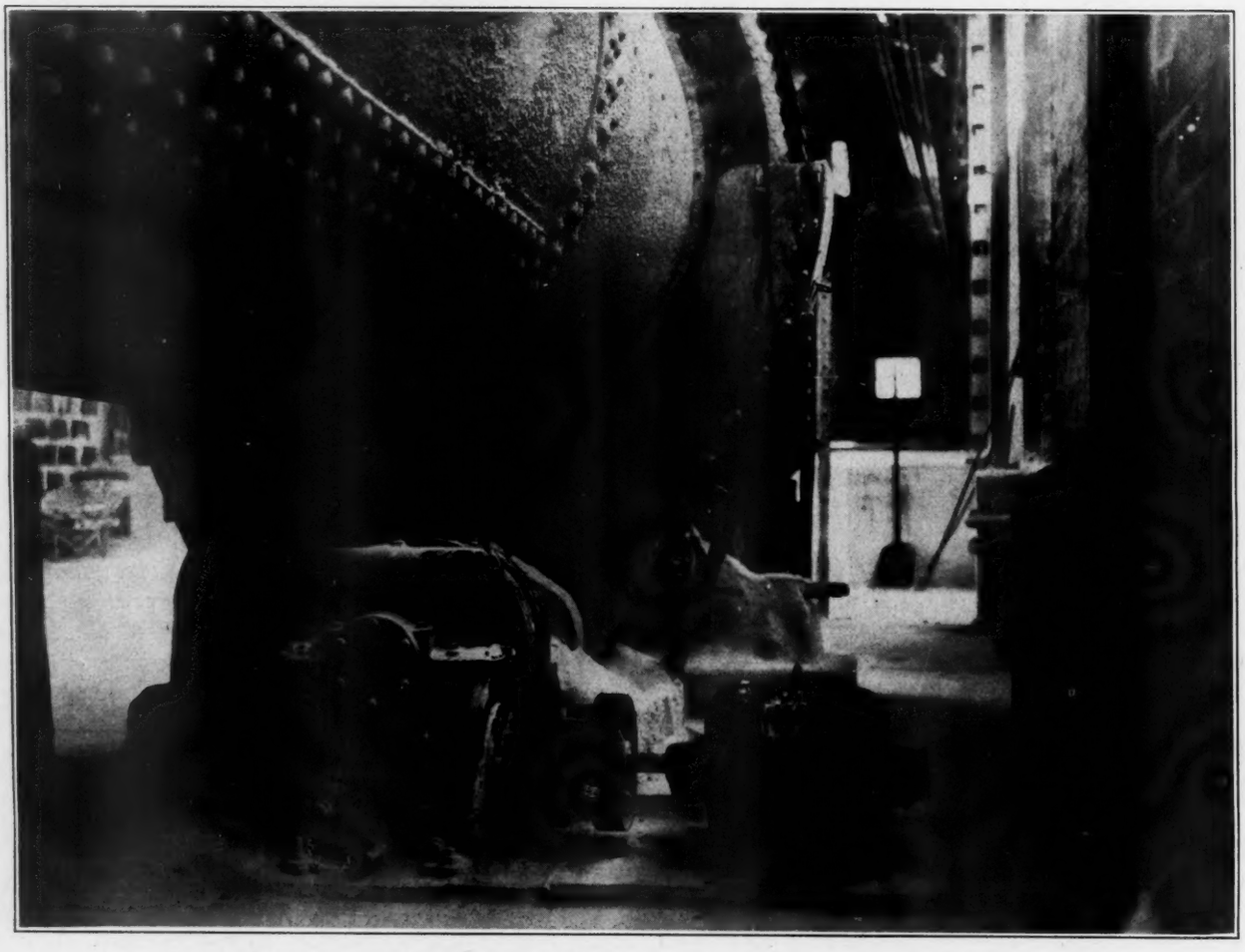
The character of service to be performed is the most important operating condition. The load and temperature are important. Some types of speed reducers will stand up better under a heavy initial shock than others. Some types of reducers will be more efficient than others when the load is intermittent while other types are only efficient when the load is continuous. Some types of speed reducers will transmit horsepowers above 100 better than others. If conditions surrounding the proposed installation site are dusty, a dust proof housing is essential. If space is an item it is possible to select a type that takes less space. If the drive is straight, offset or right hand it should be considered as some types are more efficient for some drives than others.

If the completed installation is to be in close quarters the accessibility of each type should be carefully compared. Vibration and quietness should always be given consideration. The equipment that the speed reducer is to drive is also a factor. Crushers, for example, present conditions that are more severe than kilns, screens, or probably any item of equipment in the pit and quarry industries. The manufacture of the speed reducer unit should be fully advised of complete operating conditions.

Lubrication is one of the vital factors to be considered in selecting and installing speed reducer units. The completeness, economy and effectiveness are the points to be considered. There should be a constant uniform flow of cool oil to all bearings and wearing surfaces for the maximum efficiency and minimum wear. The speed reducer unit for service in the pit and quarry industries should be tight to keep out dirt which is the source of much trouble. There are several systems of lubrication in use by the different speed reducer manufacturers and the completeness, economy and effectiveness of each should be carefully studied.

Bearings are an important factor in the efficiency and life of the speed reducer unit. Loose bearings often result in a hammer action on the gears and these blows cause the tooth surface to crystallize and peel until the entire tooth is destroyed. Loose bearings also result in alignment troubles which

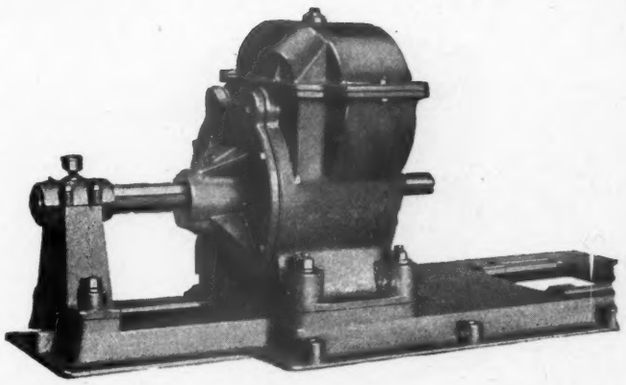
Jones Heavy Duty Worm Reducer Direct Connected to Sand Conveyor Headshaft in Plant of U. S. Silica Company



A Cleveland Reducer Driving Rotary Cooler in Lime Plant of American Lime and Stone Company

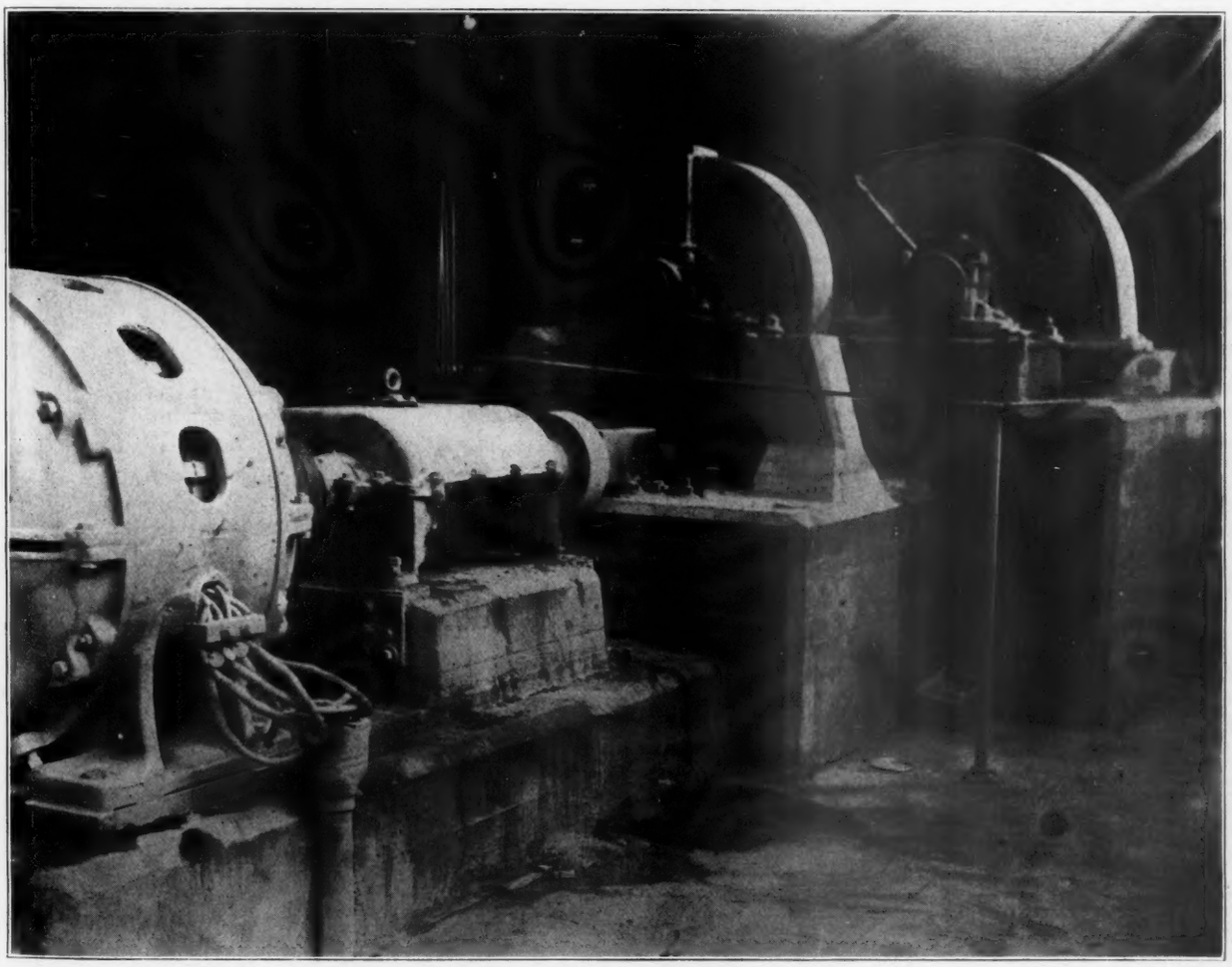
means a shearing action at the ends of the teeth. The gears should be mounted on high grade bearings and the question of bearings should be carefully considered before the purchase. Power losses due to poor bearings cannot be recovered after they have occurred.

Manufacturers of speed reducers have prepared tables which are convenient in determining what size reducer should be used. In determining the size unit to be used, the actual horsepower to be transmitted is actually taken rather than the rated horsepower of the driving motor. Some manufacturers use a capacity factor in determining the proper unit. This capacity factor is equal to the actual h.p. to be transmitted divided by the r.p.m. of the slow speed shaft. Where the h.p., motor r.p.m. and reduction ratio required have been determined this capacity factor equals the actual h.p. transmitted times the reduction ratio divided by the r.p.m. of the motor. With the capacity factor known the proper size unit can be found in the table. The unit selected should have a capacity factor equal to the one figured or as close as possible but higher. The capacity factor of the unit selected should not be less than that figured. The h.p. capacity of the unit selected should also not be less than the actual h.p. to be transmitted. It should be the same or nearly the same but higher. These tables are different with individual manufacturers to some extent so when figuring what unit to select it is well to secure these tables from the manufacturers and make a close study of them.



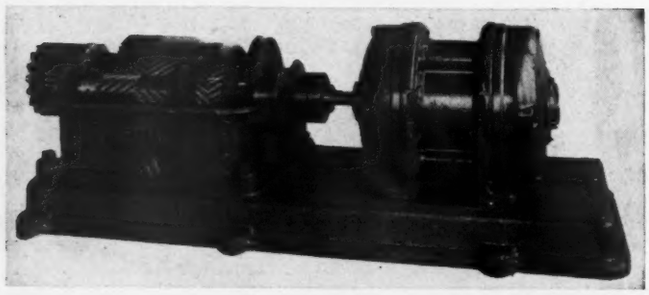
Industrial Type Hill Reducer With Outboard Bearing.

Outboard bearings are recommended as safe practice when there is a question concerning the load on a chain or belt connection from the high or low speed shaft if this arrangement is used. Overhung sprockets can usually be chosen large enough to keep this chain or belt pull with the necessary limits.



Huron Mill Type Speed Reducer Driving A Kiln.

A James Heavy Duty Worm Gear Speed Reducer



Link Belt Herringbone Reducer

Flexible couplings are an advantage between shafts of direct connected units. They are a safety factor of great importance in keeping the unit in alignment. The motor should always be flexibly connected to pinion shafts and it is often an advantage to use a flexible connection on low speed shafts that are direct connected to driven machines.

Complete data on a proposed installation is helpful to the manufacturer of speed reducers. Many problems can satisfactorily be answered by mail if complete details are submitted first to the speed reducer manufacturer. If the following factors are covered a definite recommendation can be made.

(1) What equipment is to be driven?

(2) What source of power is to be used?

(3) What conditions as to space, dust, etc., surround the proposed installation?

(4) What actual horsepower is to be transmitted?

(5) What reduction ratio is desired?

(6) What are the speeds of the driving and driven shafts?

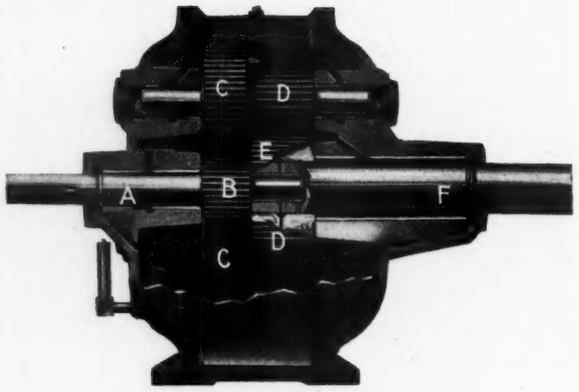
(7) Are the driving and driven shafts in straight line, right angle or offset?

(8) What will be the direction of rotation of the driving and driven shaft?

(9) What will the duty condition be? Uniform, heavy, shock loads, continuous, intermittent, etc.

(10) Will there be any overhang loads on either shaft or any thrust loads to consider?

With this data, the manufacturer can better determine whether or not his unit is suitable. When all these facts are set forth it is possible that some units will automatically be eliminated. These questions must be taken into account in making a study in the first place and the manufacturer should have the benefit of this information.



A Jones Spur Gear Reducer

Speed reducers are an economic advantage to any plant. However there is no hard and fast rule for selecting them. The specific conditions must be studied in each case.

Cements and Phosphoric Acid

The method of preparing cement clinker and free phosphoric acid from crude calcium phosphate is essentially as follows: Raw calcium phosphate is treated by a wet method to give phosphoric acid or a soluble phosphate, and difficulty soluble calcium salt which is mixed with silica, clay, or other material containing aluminum, heated to drive off the acid radicle from the calcium salt and leave a cement clinker. The regenerated acid is used to treat further phosphate. The process is carried out in this way: Silicon tetrafluoride is led into an aqueous suspension of calcium phosphate; silica and hydrofluoric or hydrofluorsilicic acid are formed, which react to give phosphoric acid and calcium fluoride. Clay, iron oxide and silica are added to the residue after filtering off the acid, and the whole burnt to yield a cement clinker, the fluoride being driven off as silicon tetrafluoride. Steam may be blown into the lower hotter part of the furnace and hydrofluorsilicic acid thus formed becomes silicon tetrafluoride, which may be led to the raw phosphate directly or after decomposition, as hydro fluorsilicic acid. F. G. Liljenroth (Sweden) (British Patent 282,704).

Crammed Full of Useful Data

M. Agress, of the Standard Potash Company, Republic Bank Building, Dallas, Texas, writes of Pit and Quarry as follows: "I esteem your publication very highly, it usually is crammed full of useful and interesting information."

PIT AND QUARRY FOREIGN DIGEST

Concrete and Cold Weather

Many cement users seem to forget that the setting and hardening of cement are chemical processes which are accelerated by heat and retarded by cold, and when a spell of cold and perhaps frosty weather has its inevitable effect in delaying the hardening of concrete the tendency is to blame the quality of the cement. As a rule cement purchased in December is no different from that bought in July, but there is a great difference in the behavior of cement at temperatures differing by thirty degrees or more. At temperatures below 40 degrees F., the hardening of cement is considerably retarded, while at freezing temperature and below there is also the danger of disruption of concrete which has commenced to set but has gained no appreciable strength. The frequent call for quick-*setting* cement in cold weather is made under a misapprehension, because there is not much connection between the speed of setting and the speed of hardening, and it is the latter factor which counts most in the fight against frost. A cement which has a final setting time of one-half hour may not be any harder at 12 hours than one with a final setting time of three hours, and at the period known as "final set" cement is quite susceptible to the damaging effect of low temperatures. Editor (Concrete, February, 1928).

Bond Between Concrete and Rock

There will undoubtedly be some adhesion between concrete and a clean rock surface, but it is almost impossible to give a figure for it unless the exact nature of the rock and the condition of the surface are known. Obviously a porous rock would tend to have a far better adhesion than an impervious one, and a rough surface much better than a smooth one. A wetted surface free from dust will also be very much better than a dry surface with dust on it. Possibly, on the average, 30 or 40 lbs. per sq. in. might be relied upon, but it would be safer to have the rock cut with channels slightly undercut so that the concrete gets as good a grip as possible. O. F. (Concrete, February, 1928).

Permeability of Concrete to Water

The Swiss Society of Hydraulic Technology reports the following results of their investigation. (a) Other factors being similar, concretes are less pervious to water, the greater the cement content. (b) Admixture of certain proofing agents such as powdered stone, hydraulic lime, etc. has no appreciable effect on the porosity. On the other hand, addition of a small quantity of slaked lime, about 9% of the weight of the cement raises the resistance to water, a greater amount causing a lowering. (C) The porosity of concrete is strongly dependent upon the setting water added. But the per cent of water in terms of the dry material is no criterion. The finer the gravel and sand, the greater the amount of water required. (d) Concrete from natural gravel and sand was found tighter to water than similar concrete made from crushed stone and sand. (2) A moist cured concrete is much less porous than a concrete cured dry. (f) The length of hardening period is without noticeable effect upon the porosity. (g) An automatic water proofing effect occurs on exposure to water, and for this reason the maximum porosity does not necessarily correspond to the moment of maximum water pressure, but is often reached before the latter. (h) Ordinary finishing grout 1:2 and 1:3, cement to sand, in a thickness of 2-3 cm. without special smoothening of the face, remains water-tight for low water pressures, up to 45 ft. Higher pressures effect a complete moistening of the grout. Comparisons of this grouted concrete were made with concrete painted with asphalt. Some of the latter showed a good watertightness, but others were only slightly improved. The committee concludes that the more free calcium hydrate a cement contains, and the more soluble bicarbonates in the setting water, the greater the amount of slurry formed and the greater ultimate impermeability of the concrete. W. Petry (Zement, February 23, 1928).

Cement and Ammonium Sulphate

The decomposition of calcium sulphate by ammonium carbonate to form ammonium sulphate and calcium carbonate is carried out in the presence of clay, kaolin, bauxite, or other substances containing silica, alumina and iron oxide, so that the pasty residue after separation of the ammonium sulphate is suitable for making Portland cement. An aqueous mixture of gypsum, clay, kaolin, etc., is treated with ammonia gas or mixed with ammoniacal liquor, and carbon dioxide under pressure is passed through. The temperature is maintained preferably at 35-45 deg. C., at the commencement and is regulated so as not to rise above 75 degrees C. Carbon dioxide recovered in the production of the cement is used again in the process. Soc. Anon. de Mat. de Construction (Paris) (British Patent 282,-755).

Glazing Stone

A glaze-like surface is produced on stone and pottery by the use of synthetic resins made from formaldehyde and phenol, or urea or mixtures of both. The resin is applied in solution in organic solvents mixed with pigments, and the objects are heated 3-5 hours after each application. Two to three coats are applied. K. Stoll (Germany) (British Patent 282,786).

INTIMATE NEWS OF MEN AND PLANTS

Upham Completes Tour

Charles M. Upham, an American engineer, has completed an inspection tour of the highways of Guatemala. It is expected that a road joining the United States with the capital of Guatemala will be completed within a few years.

J. H. Wasson Joins Staff of Peerless Egyptian

J. H. Wasson, formerly field engineer for the Portland Cement Association in the Detroit territory, has joined the newly consolidated Peerless-Egyptian Cement Company of Detroit as engineering representative. Previous to his association with the Portland Cement Association, Mr. Wasson was engaged in various types of railway and highway work and had two years service in the World War. He is a member of the Detroit Engineering Society, American Society of Civil Engineers and the American Concrete Institute.

Phosphate Rock in 1927

The total quantity of phosphate rock sold or used by producers in the United States in 1927 was 3,166,102 long tons, valued at $11,234,863, according to figures compiled by the United States Bureau of Mines, Department of Commerce, from individual reports furnished by producers. The figures for Florida were collected in cooperation with the State Geological Survey. The compilation indicates a decrease of 1 per cent in quantity and an increase of 3 per cent in value, as compared with 1926. The quantity and value, by States, of the various kinds of phosphate rock sold or used by producers in 1927 were as follows:

		Long tons	Value
Florida:	Hard rock	131,254	$ 525 016
	Land pebble	2,506,166	8,121,146
		2,637,420	8,646,162
Idaho:	Western rock	45,260	259,405
Tennessee:	Blue and brown rock	477,172	2,300,296
Wyoming:	Western rock	6,250	29,000
		3,166,102	$11,234,863

Florida continued to lead in production, and was the source of 83 per cent of all the phosphate rock sold or used by producers in the United States in 1927. Land pebble rock constituted 95 per cent of the Florida output in 1927, and showed a decrease of 3 per cent in quantity and 1 per cent in value, as compared with 1926; the average value f.o.b. mines was $3.24 a long ton in 1927, as compared with $3.17 a ton in 1926. The hard rock production in 1927 increased 13 per cent in both quantity and value, as compared with 1926; the average value f.o.b. mines in 1927 was $4 a long ton, the same as in 1926. The production of phosphate rock in Tennessee in 1927 showed an increase in both quantity and value, as compared with 1926, and the average value a long ton was $4.82, as compared with $4.35 in 1926. The quantity of phosphate rock sold or used by producers in the Western States in 1927 increased 37 per cent as compared with 1926.

Imports of phosphate rock in 1927 were 28,195 long tons, valued at $292,871, or an increase of 62 per cent in quantity and 52 per cent in value, as compared with 1926. Exports amounted to 918,256 long tons, valued at $4,733,174, an increase of 23 per cent in quantity and 7 per cent in value, as compared with 1926, and included 128,819 tons of hard rock, valued at $890,344, and 789,437 tons of land pebble and other rock, valued at $3,842,830.

Keystone Holds Meeting

The stockholders of the Keystone Portland Cement Company of Nazareth, Pa., recently held their first annual meeting for the purpose of electing officers for the ensuing year and hearing the report on construction. The engineers reported that the plant at Bath will be in operation the latter part of April. John Buckland was elected president; Frank B. Franks, vice-president and general manager; E. J. Fox, treasurer; and R. P. Johnson, secretary.

Terre Haute Purchaser

The Terre Haute Gravel Company has recently purchased 150 acres of land, north of Preston, Ind., on the St. Paul road and between the Big Four and C. & E. I. railroads, where it will open a sand and gravel pit. A gravel cleaning plant will be erected and ready for operation soon, as an excavation is being made for a dredge pump and machinery will be moved from the property on Darwin road to the new plant.

R. W. Crum Appointed Director Highway Research

Announcement is made by Professor F. H. Eno, Chairman of the Executive Committee of the Highway Research Board of the National Research Council of the appointment of Mr. Roy W. Crum of Ames, Iowa as Director of the Board, effective April 1, 1928.

Mr. Crum's experience in research work well qualifies him for this position. After graduation from the Iowa State College in 1907 he was engaged on the Engineer Corps of the Pennsylvania Lines, following which he returned to Iowa State College as Associate Professor of Civil Engineering. He remained in this position for twelve years, during which time he was engaged on research work for the Iowa Experiment Station. Since 1919 he has been Engineer of Materials and Tests with the Iowa State Highway Commission where he has conducted many highway research studies, Mr. Crum has been a member of the Committee on Character and Use of Road Materials since the organization of the Board, and in 1925 he was appointed Chairman of the Culvert Investigation conducted by the Highway Research Board.

Mr. Crum is the author of a number of important research papers. He is a member of the American Society of Civil Engineers, the American Society for Testing Materials and the American Concrete Institute and is active on several research committees of those organizations.

Cement Companies Combine

A combination, including the Peerless and New Egyptian Cement Company, has recently been effected and will be known as the Peerless Egyptian Cement Company, with main offices at Detroit, Michigan. The officers of the enlarged corporation are William Hatch, president; Maynard D. Smith, vice president; John Gillespie, secretary-treasurer; Albert Gelalty, assistant secretary-treasurer; and C. C. Pick, vice president and cashier of the United States Savings Bank of Port Huron, Michigan, was named chairman of the board of directors.

Connecticut River Sand Company Completes Fifth Year With Same Plant

By H. F. Rende

The sand and gravel pumping plant of the Connecticut River Sand Company of Hartford, Connecticut, is an interesting example of a medium size operating company in New England, producing commercial sand and gravel from the bed of the Connecticut River.

Their plant was built in April, 1923, under the direction of Mr. Earl Sexton, C. E. of Hartford, Conn., cooperating with the Engineering Department of the Erie Pump and Engine Works of Medina, New York.

The pumping plant consists of one 8 inch HHD Erie centrifugal dredging pump direct connected to a 75 h.p. Bridgeport automatic gasoline engine, operating at a speed of 320 r.p.m. The pumping plant as shown by the accompanying illustration is installed on a barge 30 feet long by 16 feet wide by 4 feet deep.

The plant under normal operating conditions, with due allowance for shut-downs of all kinds, produces about 540 cubic yards per day of nine hours. The suction line is about 30 feet long and the discharge line about 35 feet long. The pump elevates sand from the bed of the river about 20 feet below the surface of the water and discharges against a vertical elevation of about 12 feet above the water level. It discharges into a dump bottom barge about 50 feet long by 20 feet wide, with a capacity of about 40 cubic yards. This dump barge, when loaded, is towed by a 40 h.p. power boat from 400 feet to 1,200 feet, depending on the depth of the water to the dumping pit along shore from which, after dumping, the sand and gravel is recovered by a drag line bucket and transferred by cable to the top of the river bank. When all these factors are taken into consideration, their normal production of 540 cubic yards per day must be considered good for this 8 inch pumping plant.

The total cost of their plant including pumping plant, one dump scow and power [illegible] was approximately $15,000. This does not include the cost of the dragline equipment.

The 75 h.p. Bridgeport engine consumes from 30 to 45 gallons of gasoline per day at 17 cents per gallon, and about two gallons of oil. The plant, exclusive of the dragline equipment requires three men to operate it; a pilot, pump operator and deck hand. The wages of the operators are from $30 to $35 per week. Under normal conditions, it has been found that the plant can be operated about 190 days per year.

The headquarters of the Connecticut River Sand Company is at East Hartford, Connecticut. Mr. R. E. Curtis is president of this company and George W. Deane is secretary, and these two men are largely responsible for the successful operation of this plant.

Behrle Joins Chicago Gravel

Mr. L. A. Behrle, formerly assistant general freight agent of the Chicago & Alton Railroad Company, is new associated with the Chicago Gravel Company as general traffic manager.

The Pumping Plant of the Connecticut River Sand Company.

Monolith Opens Office in Honolulu

The Monolith Portland Cement Company has started a comprehensive program of expansion which includes the opening of offices in Honolulu, Hawaii, according to announcement by C. A. Law, vice-president and general manager of the company. Capt. A. Bullock-Webster, special representative of the Monolith interests, left Los Angeles recently for Honolulu from which point he will direct the promotion campaign for Monolith products. Officials directing the local production and expansion program report that the plant at Monolith is rapidly nearing completion and that the new plant of the Monolith Midwest Company at Laramie, Wyoming, will be in full operation this summer.

California Materials Open

California Materials, Incorporated, which is the reorganized Sycamore Canyon Gravel Company, held an official opening of a new crushing plant at Whittier, California, on February 24, at which a dinner was served to a number of friends as well as executives of the company. Among those present at the dinner were John R. Keene, president Western Asphalt Association; F. S. Anabel, general superintendent, Pacific Electric Railways; John Fiske, mayor, San Gabriel; C. N. Weber, J. E. Mitzger and N. T. Barr of the State Department of Public Works; Chris Campbell, Mayor, Alhambra; B. G. Martin, secretary, Whittier Chamber of Commerce; Tom Moore, manager, Public Improvement Association; Paul Tood, secretary, Cement Association; M. J. Haig, secretary, San Gabriel Valley Development Association; O. S. Cooley, assistant road commissioner, Los Angeles County; and Charles A. Diggs of the Los Angeles Planning Commission. The officers of the company are A. M. Gregg, president; W. A. Johnson, vice-president; and John Gregg, secretary.

Pioneer Sand Purchases Anderson Tugs

The Pioneer Sand and Gravel Company of Seattle, Washington, has recently purchased the entire fleet of the Anderson Towboat Company, according to announcement. The purchase involves the transfer of six tug boats and three barges and will be operated by the Pioneer Transport Company. The Pioneer Company has enlarged the scope of its activities and is a large owner and operator of tow boats and barges to transport its sand and gravel to and from the bunkers.

Adams Brothers Purchase Gravel Plant

The Adams Brothers Contracting Company of Zanesville, Ohio, which has the contract for paving the road between Coshocton and Lake Park and the street through Warsaw has purchased the Dickerson Farm along the Coshocton-Warsaw road and will install a washed sand and gravel plant. A track, connecting the sand and gravel plant with the Walhonding branch of the Pennsylvania Railroad, will be laid to enable the company to ship by rail as well as supply local trade.

General Sand Purchases Wolf Creek Property

The plant and properties of the Wolf Creek Sand and Gravel Company at Delight, Arkansas, have been acquired by the General Sand and Gravel Company. The president of the company is P. Verhey, and L. C. Verhey is secretary. The plant will be in operation as soon as the alterations and improvements are completed.

Beaver Portland Resumes Operations in Gold Hill

The Beaver-Portland Cement Company of Medford, Oregon, has recently resumed operations at its plant in Gold Hill. The Beaver-Portland, of which D. L. Carpenter is president, operates the largest cement plant in the state and has a half million barrel capacity per year.

Compton Elected President

Col. R. Keith Compton, Director of Public Works of Richmond, Va., will take office as president of the American Road Builders' Association in May. Compton was elected to the highest office in the road building world at the association convention in Cleveland last January.

New Alaska Plant Starting

The Steamship Mazama recently cleared at Seattle, Washington, carrying 60 workmen for the quarries of the Pacific Coast Cement Company at Dall Island, Alaska. The ship also carried construction materials and machinery for quarrying limerock to supply the cement plant at Seattle, Washington, with raw material.

Meisnest Joins Pacific Cement

Darwin Meisnest, for nine years graduate manager for the Associated Students of the University of Washington and a director of the million and a half dollar building program at the University, has resigned to accept the position of assistant sales manager for the Pacific Coast Cement Company. Meisnest is credited by students, Alumni and faculty, with the directive, executive and financial ability which made possible the $500,000 University Stadium and the recently erected $500,000 Athletic Pavilion.

Hot Zone Linings

"Two Hot Zone Linings" is the title of an illustrated bulletin being distributed by the General Refractories Company. As the title implies, the bulletin is devoted to a description of two installations of Arcofrax, high alumina brick. In one instance, it gave 23 months service with no repairs and in the other Arcofrax has been in use 16 months with no repairs.

Eureka Company Incorporated

A $1,300,000 organization has been formed by Thomas A. Thropp, Mrs. Charlotte M. Thropp, Frank W. Thropp, John C. Wilkes and William B. Ewing to take over the business of the Eureka Flint and Spar Company, of Trenton, New Jersey. Mr. Wilkes has been designated as agent at the New York Avenue plant.

San Juan Changes Hands

The sand and gravel pit located south of Friday Harbor, Washington, owned by the Superior Sand and Gravel Company of Seattle, has been purchased by Philip Morrison of Seattle and William Gaul of Tacoma. It is announced that the purchasers will make the necessary repairs and improvements and start the plant in operation soon.

Alabama Plant Completed

The Alabama Lime and Stone Corporation of Birmingham, Alabama, has completed its plant at Calera and the kilns are operating. The lime plant is one of the largest units in the country and is equipped with the modern appliances.

Janesville Company Moves To New Offices

The Janesville Sand and Gravel Company will move its offices from the Jackman Building, Janesville, Wisconsin, to its new and attractive building on Harding Street. The new building is of T shape with a 50 foot frontage, the rear section is 40 feet in width and 30 feet in depth, containing a large basement automobile storage, storage for records and one story building for offices and work rooms. The walls were constructed of cement blocks.

DISTRIBUTION OF CEMENT

The following figures show shipments from Portland cement mills distributed among States to which cement was shipped during December, 1926 and 1927, and January, 1927 and 1928.

Portland cement shipped from mills into States, in December, 1926 and 1927, and January, 1927 and 1928, in barrels*

Shipped to—	December		January	
	1926	1927	1927	1928
Alabama	117,426	155,046	132,569	235,233
Alaska	297	132	.....	396
Arizona	39,536	59,434	54,088	82,184
Arkansas	42,245	57,179	46,014	62,143
California	901,526	826,042	998,230	1,030,965
Colorado	31,711	26,653	28,050	32,389
Connecticut	52,141	86,678	34,587	74,600
Delaware	6,528	11,949	11,170	13,077
District of Columbia	64,457	35,784	50,552	30,341
Florida	317,402	113,512	283,031	108,750
Georgia	110,139	82,539	119,770	113,857
Hawaii	25,732	15,410	22,491	20,290
Idaho	13,199	4,450	15,085	6,408
Illinois	446,515	355,233	301,829	354,763
Indiana	108,771	95,953	74,589	88,411
Iowa	37,153	23,998	38,157	30,488
Kansas	88,010	54,317	68,122	78,460
Kentucky	62,172	54,834	42,851	54,991
Louisiana	89,843	87,947	116,633	94,929
Maine	6,255	10,829	6,295	12,487
Maryland	135,181	79,514	135,015	87,650
Massachusetts	72,231	116,135	70,354	104,382
Michigan	292,167	288,891	258,848	267,206
Minnesota	40,916	31,387	41,396	50,480
Mississippi	60,858	54,701	51,325	57,528
Missouri	152,647	122,565	113,581	146,411
Montana	6,455	7,373	7,261	8,289
Nebraska	26,933	22,308	22,675	26,815
Nevada	3,150	7,165	2,724	3,293
New Hampshire	18,340	17,710	16,172	17,647
New Jersey	255,744	335,550	227,489	318,204
New Mexico	13,639	8,574	12,503	12,861
New York	788,046	974,050	†700,414	800,428
North Carolina	183,912	112,931	141,582	135,292
North Dakota	2,439	1,506	3,575	2,102
Ohio	312,336	265,784	226,786	265,048
Oklahoma	120,560	166,633	164,266	201,422
Oregon	47,637	51,119	35,715	37,133
Pennsylvania	469,376	483,869	†365,107	441,419
Porto Rico	13,250	.....	2,550	.....
Rhode Island	19,813	23,079	19,352	25,325
South Carolina	31,523	76,157	42,537	102,178
South Dakota	3,625	1,573	5,094	5,988
Tennessee	82,556	96,493	86,485	88,966
Texas	303,770	320,825	362,004	405,245
Utah	12,944	13,669	13,356	9,575
Vermont	3,844	12,700	5,606	11,363
Virginia	61,351	76,872	62,199	91,941
Washington	90,856	95,166	104,608	90,604
West Virginia	63,680	42,219	47,871	39,992
Wisconsin	95,776	89,820	76,148	74,881
Wyoming	7,430	7,691	5,972	5,262
Unspecified	396	14,566	†19,886	12,918
	6,354,439	6,176,514	5,894,569	6,473,010
Foreign countries	77,561	49,486	73,431	47,990
Total shipped from cement plants	6,432,000	6,226,000	5,968,000	6,521,000

*Includes estimated distribution of shipments from three plants in December and January, 1927, and January, 1928; and from five plants in December, 1926.
†Revised.

Production, shipments, and stocks of finished Portland cement, by districts, in February, 1927 and 1928, and stocks in January, 1928, in barrels

District	February				Stocks at end of month		Stocks at end of January
	Production		Shipments				
	1927	1928	1927	1928	1927	1928	1928a
Eastern Pa., N. J. and Md.	2,353,000	2,135,000	1,708,000	1,455,000	5,761,000	6,566,000	5,886,000
New York	229,000	305,000	215,000	288,000	1,453,000	1,778,000	1,761,000
Ohio, Western Pa. & W. Va.	865,000	978,000	543,000	487,000	2,942,000	3,393,000	2,903,000
Michigan	263,000	291,000	334,000	316,000	2,019,000	2,194,000	2,218,000
Wis., Ill., Ind., & Ky.	450,000	901,000	652,000	578,000	3,239,000	3,732,000	3,409,000
Va., Tenn., Ala., Ga., Fla. & La.	1,020,000	1,037,000	992,000	922,000	1,197,000	1,967,000	1,851,000
Eastern Mo., Ia., Minn. & S. D.	404,000	747,000	362,000	319,000	3,241,000	3,955,000	3,527,000
Western Mo., Neb., Kan. & Okla.	236,000	387,000	527,000	495,000	1,556,000	1,647,000	1,655,000
Texas	396,000	460,000	382,000	423,000	475,000	460,000	423,000
Col., Mont., Utah	65,000	108,000	101,000	85,000	482,000	496,000	473,000
California	888,000	1,164,000	736,000	1,016,000	707,000	764,000	616,000
Ore. & Wash.	208,000	172,000	179,000	175,000	491,000	387,000	391,000
	7,377,000	8,785,000	6,731,000	6,559,000	23,563,000	27,339,000	25,113,000

Relation of Production to Capacity

	February		January	December	November
	1928	1927	1928	1927	1927
	Per cent	Per cent	Per cent	Per cent	Per cent
The month	47.5	44.6	49.4	60.7	75.9
The 12 months ended	75.1	76.2	74.5	76.2	73.7

FEBRUARY CEMENT STATISTICS

The Portland cement industry in February, 1928, produced 8,785,000 barrels, shipped 6,559,000 barrels from the mills, and had in stock at the end of the month 27,339,000 barrels, according to the United States Bureau of Mines, Department of Commerce. The production of Portland cement in February, 1928, was 19 per cent greater, and shipments about 3 per cent less, than in February, 1927. Portland cement stocks at the mills were 16 per cent higher than a year ago.

The statistics here presented are compiled from reports for February from all manufacturing plants except two, for which estimates have been included in lieu of actual returns.

The output of finished cement by the 155 plants active during February, 1928, was equivalent to 47.5 per cent of the estimated capacity, as compared to an output of 44.6 per cent of capacity of the 141 plants active in February, 1927. Similar comparisons for other periods are given below:

Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent ad trade-mark attorney, Continental Trust Building, Washington, D. C., at the rate of 20c each. State number of patent and name of inventor when ordering.

1,659,922. Apparatus for making concrete poles. George B. Heath, St. Louis, Mo.

1,659,109. Portable conveyor and pourer. John D. Lawrence, San Diego, Cal.

1,659,211. Machine for cutting and sifting sand. Verne E. Minich, New York, N. Y., and Elmer A. Rich, Jr., and Raymond H. Moore, Chicago, Ill., assignors to American Foundry Equipment Co., New York, N. Y.

1,659,504. Subgrade planer. George E. Webb, Milwaukee, Wis., assignor to Koehring Co., same place.

1,659,557. Sifter. William Adelmann, New York, N. Y.

1,659,651. Road-paver. Raymond L. Greist, Chicago, Ill., assignor to Leach Co., same place.

1,659,668. Grinding-mill. Russell Shepheard, Cleveland, Ohio.

1,659,750. Concrete mixer and conveyor. Jesse L. Stollings, Los Banos, Cal.

1,659,824. Dipper-door control for shovels. Erich H. Litchenberg, Milwaukee, Wis., assignor to Koehring Co., same place.

1,659,889. Mining-machine. Edmund C. Morgan, New York, N. Y.

1,660,459. Interfitting blocks for road paving. John G. Thomson, Edinburgh, Scotland.

1,659,971. Process of hardening and aging calcined gypsum products. James H. Colton, Berkeley, Cal., assignor to Pacific Portland Cement Co., San Francisco, Cal.

1,660,083. Mining-machine. Edmund C. Morgan, New York, N. Y.

1,660,142. Crowding mechanism. Carl G. Wagner and John M. Kerr, Bay City, Mich., assignors to Bay City Dredge Works.

1,660,221. Mixing and crushing machine. Chandos R. Dimm, Muncy, Pa., assignor to Robinson Mfg. Co., same place.

1,660,421. Pavement. Herbert M. Knight, Montclair, N. J.

1,660,589. Gravel-washing machine. Theodore Aulman, Des Moines, Iowa.

1,660,598. Latch-guide for dredge-buckets. Ernest E. Crane, Minneapolis, Minn., assignor to American Manganese Steel Co., Chicago, Ill.

1,660,652. Rock-crusher. Alfred Molander, St. Paul, Minn.

1,660,816. Mining-machine. Thomas E. Pray, Chicago, Ill., assignor to Goodman Mfg. Co., same place.

1,661,244. Loader for cement-mixers. Carl J. Westling, Waterloo, Iowa, assignor to Construction Machinery Co., same place.

1,661,407. Paving-block. Alton W. Butler, West Bridgewater, Mass.

1,661,628. Coal cutter and loader. Charles B. Officer, Chicago, Ill., assignor to Sullivan Machinery Co., Claremont, N. H.

1,661,629. Mining apparatus. Charles F. Osgood, Claremont, N. H., assignor to Sullivan Machinery Co., same place.

1,661,828. Paving material and method of laying it. Ernest Hopkinson, New York, N. Y.

1,661,832. Paving material and process of making it. Friedrich Iwanski, Berlin-Copenick, Germany.

1,662,170. Implement for handling and working concrete. Gustav R. Sahlstrom, Rockford, Ill.

1,662,274. Worm-drive mixing-machine. Philip A. Koehring, Milwaukee, Wis., assignor to Koehring Co., same place.

1,662,455. Mining-machine. Kenneth Davis, Ebensburg, Pa.

1,662,719. Mining apparatus. Edward B. Robinson, Brentwood, England, assignor to Sullivan Machinery Co., Chicago, Ill.

1,662,776. Apparatus for slaking lime into lime putty. David A. Evans, Kansas City, Mo., assignor to Evans Lime Putty Co., Kansas City, Kans.

1,662,786. Mining-machine. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co.

1,662,787. Mining apparatus. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co.

(*Continued on page 95*)

EXPORTS AND IMPORTS

Compiled from the records of the Bureau of Foreign and Domestic Commerce. Figures for 1928 subject to revision

Exports of hydraulic cement by countries in January, 1928

Exported to—	Barrels	Value
Canada	2,910	$ 10,377
Central America	5,432	13,904
Cuba	6,718	17,659
Other West Indies and Bermuda	3,464	8,834
Mexico	5,087	16,643
South America	27,804	108,420
Other countries	4,985	29,038
	56,400	$204,875

Imports of hydraulic cement by countries, and by districts, in January, 1928

Imported from—	District into which imported—	Barrels	Value
Belgium	Florida	23,008	$ 31,755
	Galveston	6,000	9,762
	Massachusetts	27,685	42,041
	North Carolina	1	5
	Porto Rico	200	250
	Sabine	3,000	5,700
	South Carolina	95,597	128,546
	Total	155,491	218,059
Canada	Maine and New Hampshire	242	505
	Saint Lawrence	1,010	1,954
	Vermont	160	209
	Total	1,412	2,668
Denmark	Oregon	3,000	3,205
	Porto Rico	37,230	47,230
	Total	40,230	50,435
France	New Orleans	119	131
Germany	New York	7	18
Italy	South Carolina	30,000	62,180
Japan	Oregon	2,000	2,469
United Kingdom	New York	4,999	6,229
	Philadelphia	495	608
	Total	5,494	6,837
	Grand total	234,753	$342,797

Exports and imports of hydraulic cement, by months, in 1927 and 1928

Month	Exports				Imports			
	1927		1928		1927		1928	
	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value
January	75,346	$ 254,072	56,400	$204,875	193,175	$ 269,661	234,753	$342,797
February	71,404	233,985	.....	.....	130,421	200,680	.....	.....
March	67,956	240,165	.....	.....	181,145	261,519	.....	.....
April	72,383	243,832	.....	.....	191,868	313,262	.....	.....
May	59,332	205,574	.....	.....	178,929	263,618	.....	.....
June	69,205	237,281	.....	.....	129,111	201,682	.....	.....
July	72,337	229,737	.....	.....	175,035	249,665	.....	.....
August	61,371	209,198	.....	.....	117,605	170,167	.....	.....
September	57,888	207,817	.....	.....	233,066	297,716	.....	.....
October	67,639	230,668	.....	.....	221,274	321,777	.....	.....
November	79,869	257,476	.....	.....	141,485	190,419	.....	.....
December	62,099	226,960	.....	.....	156,609	209,205	.....	.....
	816,829	$2,776,765	.....	.....	2,049,723	$2,949,371	.....	.....

Domestic hydraulic cement shipped to Alaska, Hawaii, and Porto Rico, in January, 1928

Alaska	155	$ 478
Hawaii	9,417	22,405
Porto Rico	4,100	9,215
	13,672	$32,098

Production, shipments, and stocks of finished Portland cement, by months, in 1927 and 1928 (In thousands of barrels)

Month	Production		Shipments		Stocks at end of month	
	1927	1928	1927	1928	1927	1928
January	8,258	*9,766	5,968	*6,540	22,914	*25,175
February	7,377	8,735	6,731	6,559	*23,563	27,339
March	*11,450	.....	*11,100	.....	23,922	.....
April	14,048	.....	14,350	.....	23,654	.....
May	16,701	.....	16,865	.....	23,503	.....
June	17,224	.....	19,761	.....	20,972	.....
July	17,408	.....	18,984	.....	19,397	.....
August	18,315	.....	21,411	.....	16,292	.....
September	17,505	.....	19,828	.....	13,996	.....
October	17,174	.....	18,105	.....	13,141	.....
November	14,449	.....	11,619	.....	*16,022	.....
December	11,999	.....	6,200	.....	21,821	.....
	171,908	.....	170,922	.....	.....	.....

NEWS OF EQUIPMENT MANUFACTURERS

New Rock Drill Literature

Ingersoll-Rand Company, 11 Broadway, New York City, has just published several new bulletins describing its various rock drills.

The bulletins cover Ingersoll-Rand Drifter Drills, Wagon Drills, "Little Tugger" Hoists, and Drill Steel Sharpeners. Copies of these bulletins, nicely bound in an embossed cover, will be sent to anyone interested. A brief summary of each booklet is given below.

Bulletin 4063, drifter drills, is a thirty-two page catalog describing in detail the 125-pound N-72, the 164-pound R-72, and the 208-pound X-72 drills. The introduction, which is entitled "The Evolution of the Rock Drill," gives a brief history of the development of drills and also shows a line drawing of the first percussion drill ever made (1849).

The bulletin is well illustrated, containing several full-page views of the drills in operation under various drilling conditions. There are also close-up and sectional views showing details of the drills themselves. The bulletin is divided into chapters on mining, tunnelling, and quarrying. Under each of these headings are the recommendations of Ingersoll-Rand Company covering proper drill for each kind of work.

Bulletin 4072, wagon drills, is a four-page bulletin containing interesting performance data on the Wagon Drills as used in crushed stone quarries. It describes both the large and small models.

Bulletin 4159, "Little Tugger" hoists, is besides a description of the three sizes of "Little Tugger" hoists now manufactured, this bulletin devotes some sixteen or eighteen pages to the "Various Types of Scrapers, Slides, and Methods of Mining to which the 'Little Tubber' is being applied." One or more of the systems illustrated can be applied to almost any of the mining methods now in use, and the bulletin should prove especially interesting wherever "slushing" is used or wherever "slushing" can be profitably applied.

Bulletin 4422—drill steel sharpeners, is the most impressive of the entire group. Like most of the others in the series, it has 32 pages and is well illustrated with cuts showing the details of various important parts, such as the crosshead, crosshead rod, piston, etc.

The introduction is unusually interesting, outlining the 20 years of pioneering in sharpener construction and the reasons for the heavy design.

Included in the bulletin is a two-page drawing of a "Practical Blacksmith Shop." Ingersoll-Rand Company informs us that this layout was made by its engineers as a result of numerous inquiries from mines and quarry operators. It is an excellent layout of sharpener equipment for a modern, up-to-date shop.

New Arc Welder

A new Westinghouse, 200 ampere, single-operator welding set has been designed to meet every requirement in both the shop and field, and to serve all applications, within its rating, with speed and economy. This new unit is outstanding in its features of simplicity of operation and compactness in construction.

The set is started by connecting directly across the line by means of a LINESTARTER and LINESTART motor. Starting and stopping are accomplished by the simple operation of a pushbutton. A single rheostat varies the arc current over the entire welding range. Accurate adjustment over the welding range, from 60 amperes to 300 amperes, is afforded by steps of 5 amperes.

The motor-generator, and control equipment are assembled in a totally enclosed frame. The exciter, which is overhung from the motor end, is securely fastened to the unit frame. This type of construction guards the operator against injury, and protects the set from dirt and falling objects. In performance tests welding operations have been carried on while the sets were suspended at every angle that could possibly be required in any application. Operation is as satisfactory when the set is placed on end, as when it is in the normal position.

Steady welding current, insuring thorough penetration and fusion of the weld, is obtained from a constant current generator. A separate exciter is used in all Westinghouse single-operator welders. It insures a high speed of welding, and a machine whose generator voltage responds to any changes in arc conditions, this tending to maintain a constant rate of fusion of the electrode.

The unit is rated at 200 amperes, 1 hour, 50° rise on a resistance load at 25 volts which conforms to the standard rating of the National Electrical Manufacturers Association. The motor is wound for 220 or 440 volts and is assembled with the necessary connections made for operation from a 3-phase, 60 cycle circuit. If it is desired to operate the unit from a 440 volt, 3-phase, 60 cycle circuit, it is only necessary to replace the operating coil on the magnetic starter, and to reconnect the motor leads.

Recent Patents

(*Continued from page 94*)

1,662,788. Mining-machine. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co.

1,662,789. Mining-machine. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co.

1,662,794. Mining-machine. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co.

1,662,795. Mining-machine. Louis A. Maxson, Claremont, N. H., assignor to Sullivan Mahinery Co.

1,662,786. Mining-machine. Charles F. Osgood, Claremont, N. H., assignor to Sullivan Machinery Co.

1,662,787. Mining-machine. Charles F. Osgood, Claremont, N. H., assignor to Sullivan Machinery Co.

1,662,788. Mining-machine. Charles F. Osgood, Claremont, N. H., assignor to Sullivan Machinery Co.

1,662,799. Mining-machine. Charles F. Osgood, Claremont, N. H., assignor to Sullivan Machinery Co.

1,662,800. Mining-machine. Gilbert Rimmer, London, England, assignor to Sullivan Machinery Co.

Perfex Opens New Office

The Perfex Corporation, of Milwaukee, builders of heavy duty industrial engine radiators, announce the opening of a Cleveland office in the Leader Building. Mr. A. C. Owen, formerly located at New York, will be in charge of this office, taking over all the Ohio territory in addition to the Eastern states which he formerly covered.

Allis Chalmers Opens Office at New Haven, Conn.

Mr. E. D. Hill of the Allis Chalmers Manufacturing Company, will be located at 42 Church Street, New Haven, Conn. This will enable the Company to more effectively serve this community in connection with motors, pumps and Texrope drives. The sales will be under the direction of Mr. A. F. Rolf, manager Allis Chalmers New York office, 50 Church Street.

Describes Silent Hoists

The Silent Hoist Winch and Crane Company is distributing its illustrated "Silent Hoist, Bulletin 27." The products of the company consist of vertical and horizontal capstans, single and double drum winches. The illustrations show many self contained units with electric motor and gasoline drives.

New Solenoid Brakes

Simplification is the keynote of a complete new line of solenoid brakes now offered by the General Electric Company. The line bearing the designation CR-9516, includes brakes for operation on alternating and direct current, and involves in its construction the use of a spring setting device—a new feature for alternating current applications. The announcement follows developmental work over a period of years.

The brakes are especially designed for severe service in connection with mill, crane and hoist motors. The manufacturer claims smooth operation for making quick stops in either direction of rotation, with a dependable holding value. The brake mechanism is held in the "off" position by a coil and plunger; when power is applied to the motor, the coil is energized and the brake is released, and, when the power is shut off, the spring setting device forces the mechanism into the closed or braking position.

Both alternating and direct current brakes use the same brake mechanism and frame, the solenoids being interchangeable. Further flexibility is obtained by making the floor-mounted brake the basic unit of the line; by adding a mounting bracket, it becomes a motor-mounted brake. The brakes, being spring-set, can be mounted in any position, have adjustable torque, allow no sudden jar from falling armature and have a simple and accessible overhead lever construction.

Exceptionally small diameter brake wheels are used, minimizing flywheel effect and reducing WR^2 values. A wide wheel face gives ample braking surface. The brake shoes are of cast iron and are self-aligning, permitting proper contact with the wheel even when the brake is incorrectly mounted and the wheel is out of line with the brake both sidewise and up or down. Compressed, woven asbestos lining furnishes the braking surface for the shoes, and is not affected by heat or moisture.

The brake yokes of plate steel are pivoted below the wheel near the center line and cover rim on both sides of the wheel so that it cannot come off the shaft accidentally.

The solenoid assembly may be quickly removed from the brake mechanism by taking out four bolts, lever or brake adjustments remaining undisturbed. The coil only may be removed, if desired, from the larger sizes.

New Good Roads Crusher

The Good Roads Machinery Company is distributing its February issue of Good Roads, in which Good Roads crusher, Number 1030, is especially featured as a new member of the rock crushing family. The side plates are of carbon steel 1¼ inches thick and are tied together through the stationary jaw and toggle seat retainer castings, as well as by through rods passing through the machine. Eccentric shaft is a steel forging, equipped with two SKF and four Timkin roller bearings. The over all width of the crusher is 5 feet 10 inches; length, 4 feet 8 inches; and height, including pulleys, is 5 feet. It operates at a speed of 365 r.p.m. with a 25 ton capacity per hour.

In addition, a portable crushing and screening plant is featured which was used to crush hard head Wisconsin boulders. On a check of actual crushing capacity the machine turned out a volume of 60 tons of crushed material in two hours with the jaws set to close at ¾ inch. The 10 by 30 inch crusher was the one used at the portable gravel plant and is said to have operated over a period of five months with no indication of heating or necessity for repairs.

Alexanderson Awarded Medal

Dr. E. F. W. Alexanderson, consulting engineer of the General Electric Company and Radio Corporation of America, was presented the John Ericsson medal at the 40th anniversary banquet of the American Society of Swedish Engineers in New York, February 11. The award was given Dr. Alexanderson "for his outstanding contribution to the field of radio engineering." The medal, founded in honor of the great scientist and engineer, Captain John Ericsson, has been awarded but once before. This was in 1926 when Dr. Svante Arrhenius, former head of the Nobel Institute and the first man to advance the theory of ionization, received it.

Gravity Storage Bins Discussed

The Neff and Fry Company is distributing a 160 page, illustrated manual on "Gravity Storage Bins." The work includes a story of the progress of the company since it began to work on the idea that a storage bin should embody all the features of a sky scraper. It also shows the old and new methods of storage.

The manual tells a story of the manufacture of gravity storage bins and the gravity loading gate, and shows the processes of manufacture, illustrated with photographs. Included are a number of pictures of installations in all parts of the country, together with letters from firms who are satisfied with the labor saving and time saving value of the bins and equipment.

National Hoisting Additions

Theodore Hanan has been appointed sales manager of the hoisting machinery department of the National Hoisting Engine Company, of Harrison, N. J. The following new agents have also been appointed: G. E. Hillsman Company for Chicago, Illinois, and Indianapolis, Indiana; O. B. Avery Company for St. Louis, Missouri, and Little Rock, Arkansas; Browning Ferris Machinery Company for Dallas, Fort Worth, Houston, and Amarillo, Texas; and Clark Wilcox Company for Boston, Massachusetts.

New Belt Conveyor Carrier

A new Rex-Stearns belt conveyor carrier has just been announced by the Stearns Conveyor Company of Cleveland, Ohio, for mounting their pressed steel and chilled rim cast iron idler units.

Several noteworthy features are included in the design. The supporting brackets are made of certified malleable iron.

The spacing between idlers is reduced to $\frac{5}{16}$" on this new Rex-Stearns carrier. With this close spacing, there is very little chance of the belt 'creasing" and being worn accordingly. With this new type of bracket, it has been possible to secure this close spacing and at the same time keep the idlers safely mounted and quickly and completely interchangeable.

The carrier is offered in the following sizes: 18", 20", 24", 30" and 36", with either Rex-Stearns pressed steel or chilled rim cast iron idlers, both having one-piece pulley shell construction, Timken bearings, long time lubrication, and the Stearns positive grease seal which serves the double purpose of keeping dust out of the idler and grease within it.

The new idler is interchangeable with previous Stearns units. The Stearns Conveyor Company is owned by the Chain Belt Company in Milwaukee, Wisconsin, who manufacture chain conveying equipment.

New Incorporations

Apex Sand & Gravel Co., 519 Seventeenth St., Denver, Colo. $20,000. N. Lindblad, B. E. Carleno, E. C. Armstrong.

Ozaukee Sand & Gravel Co., 1432 Green Bay Ave., Milwaukee, Wis. 1,000 shares, $100 each. Henry Ripple, Frank Ripple, Alois Meenecke.

Pyramid Rock Asphalt Co., Inc., 50 E. 42nd St., New York City. Charles J. Crowley, Pres.; Harold F. Fisher, V.-P. and Treas.; Walter Hohenhausen, Sec. 1,000 shares n.p.v.

Muscle Shoals Cement Co. of Southern Calif., Coyote Wells, Calif. $2,000,000. V. E. Pierson.

General Sand & Gravel Co., Delight, Ark. P. Verhey, Pres.; L. C. Verhey, Sec. $1,000,000. Purchased plant of Wolf Creek Sand & Gravel Company.

Pure Asphalt Corp., Kansas City, Mo. $20,000. Earl E. Albright, B. C. Duncan, I. A. Pringle. (Representative of Pure Asphalt Corp., 1750 N. Tripp Ave., Chicago, Ill.)

California Talc Co., care of Bert Campbell, Esq., 1200 Edwards & Wildey Bldg., Los Angeles, Calif. $150,000.

Sand & Gravel Service, 127 Albany St., New Brunswick, N. J. 500 shares n.p.v. John J. Bulfin, Harry L. Ivins, James W. Rea.

Associated Rock Co., Los Angeles, Calif. $500,000. G. W. Grabe, Edward Schlee, H. W. Jones.

Diamond Gravel & Navigation Co., 17 Parkside Ave., Buffalo, N. Y. 200 shares n.p.v. E. E. Becker, F. H. Holtz, C. H. Lanctot, F. C. Westphal.

Flint Rock Co., Odessa, Tex. J. T. Nikon, O. L. Rifner, B. A. Reynolds. $50,000.

Peoples Sand & Supply Co., Wichita, Kans. $10,000. Pumping operation.

Pope Sand & Gravel Co., Yonkers, N. Y. 1,000 shares n.p.v.

Salem Quarries, Inc., Winston-Salem, N. C. $125,000. George H. Cox, H. C. Perkins.

Southern Asbestos & Magnesia Corp., Los Angeles, Calif. $100,000. Stanley L. Plant, James A. Flannagan, Clyde E. Grafton.

Swendsen-Richards, Inc., Seattle, Wash. $2,000. W. C. Richards, Ofell H. Johnson.

United Rock Asphalt Co., Nashville, Tenn. $200,000. C. H. Anderson, Benton McMillin, J. F. Ashley, Z. E. Robinson, W. T. Lasley, A. H. Roberts.

Marus Marble & Tile Co., care of Central Mosaic Marble & Tile Co., 248 N. Front St., Memphis, Tenn. $30,000. Paolo Marus, A. L. Alexander, A. J. Yates, John Marus, Gene Marus.

Rock Products Corp., 813 Dan Waggoner Bldg., Fort Worth, Tex. $15,000. A. P. Haddix, Pres.; S. V. Evans, V.-P.; Austin F. Anderson, Sec.-Treas.

New Sand and Gravel Plant at Hawarden, Iowa

Worden, Allen and Company has started the erection of a sand and gravel plant for the L. G. Everist Company at Hawarden, Iowa. A. G. Henderson is erecting engineer and is working 16 men with the view of completing the model plant at the earliest possible date.

Another Cement Plant

The Carolina Cement Company, which has been recently organized with J. A. Acker as president, will start building the first cement plant in the state. It will be located near New Bern, between the Trent River and Pembroke Road, and is being designed for a production in excess of 1,500,000 barrels per year.

Ottawa Sand Merger Formed

The American Silica Company has been formed recently to take over crude sand properties in the Ottawa, Illinois field which are valued at $1,500,000. Among the more important companies, the merger includes the Ottawa Moulding Sand Company, Buffalo Rock Silica Company and the Higby Reynolds Sand Company.

R. J. Beatty of Ottawa was elected president; Carl M. Gottfried, vice president; W. E. Ludwig, secretary, and W. H. Hinebaugh and C. E. Drier were elected directors. Offices have been leased in the Central Life Building, Ottawa, for occupancy by the company.

Pacific Rock Grades For Spur

Grading for a spur track from the Southern Pacific yards to the proposed plant of the Pacific Rock Company at Centerville, California, was recently started according to an announcement by Lee Fronty, manager of the Pacific Company. The grading is in charge of L. Malina of Newark, who will carry on the work until completed.

Lincoln Appoints Savela

The Lincoln Electric Company of Cleveland, announces the appointment of Jacob F. Savela as Welding Service Manager for the Detroit District under the direction of Mr. J. M. Robinson, District Sales Manager. Mr. Savela is a graduate of the University of Michigan and has had a wide practical experience.

The Portable Cable Drill

The Keystone Driller Company presents an illustrated story of the "Evolution of the Portable Cable Drill" by J. V. Downie. The illustrations show the Spring Pole Drill of 1877; the Well Drilling Machine of 1878; front covers of the R. M. Downie and Brother catalog of 1878 and the Keystone Driller Catalog of 1882; a photograph of the shop and employes of 1882; and a photograph of the founder of the company, Robert Magee Downie.

The story opens with the assertion that, "Wells were dug long before the dawn of history" and relates the facts of the wells in the early history of Israel and references of Confucius to the well drilling machines in use in China, during his period. The first drilled well of Western Europe is stated to have been drilled to the depth of 1780 feet in 1842 at Grenelle, near Paris, which was bored with a spring pole drill.

The steam engine was adapted to the stationary or semi-portable drill in 1830 and Billy Norris invented linked jars in 1831 while drilling for salt lime in Kanawha, West Virginia.

An adaptation of the salt well drill, with stationary derrick and steam engine, was used by Col. E. L. Drake in drilling the first oil well 68½ feet deep, near Titusville, Pennsylvania.

In 1875, Robert M. and John G. Downie adopted the spring pole, jointed rod drill for coal prospecting in Pennsylvania, and in 1876 they entered the business of drilling water wells. In 1878, they built the first portable well drill ever mounted completely on one set of wheels.

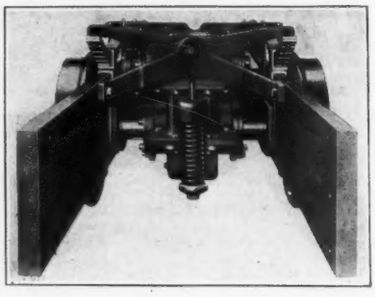
New G. E. Data

The General Electric Company is distributing some loose leaf bulletins for inclusion in the G. E. general catalog among which are GEA 808A. It is concerned with forms RA and RL totally enclosed fan cooled induction motors. These motors are made in types, KT and KI squirrel cage 10 h.p., 900 r.p.m.; 15 h.p., 1200 r.p.m.; 20 h.p., 1800 r.p.m.; and larger sizes. Types FT and FI, squirrel cage, full voltage starting; and MT and MI with wound rotor. GEA 467A, GR 7022, automatic starters for slip-ring motors. Some of the advantages are given as smooth acceleration without excess strain on the motor; insures starting of the motor even although the motor must exert maximum torque to turn the load; prevents burning out of starting resistors; and protects the motor from damage caused by over heating.

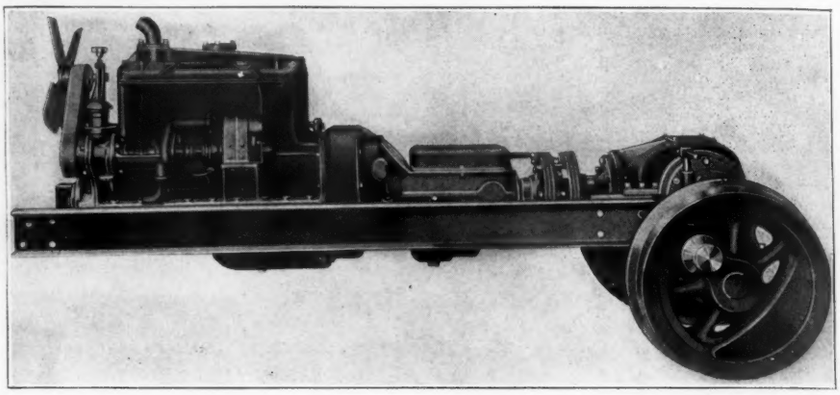
New Gasoline Locomotive

A gasoline locomotive entirely new in design and drive principle has recently been brought out by H. K. Porter and Company according to announcement by the company.

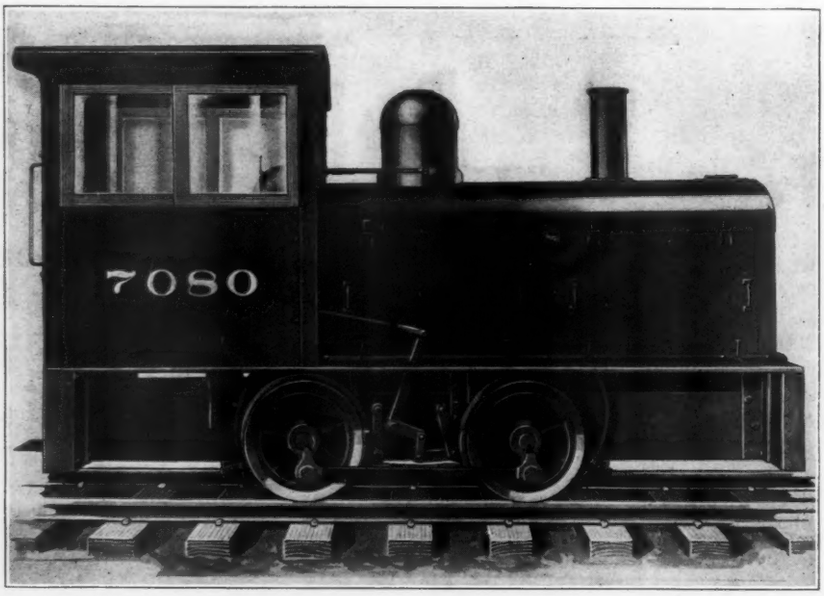
The power plant, clutch and transmission are mounted on a steel sub frame and form a straight line drive to the reverse unit. This sub-frame acts as a torque arm, pivoted on the rear axle and spring, suspended at the front to the main frame. The weight of the rear end of the sub-frame is carried on the main frame by a coil spring. This results in the engine, radiator, clutch transmission and reverse unit being mounted on a sub-frame which is spring suspended to a spring suspended cross-equalized main frame. The main frame and bumpers are made of rolled steel slabs similar to those used on the Porter steel works locomotives. The running gear including steel tired driving wheels, side rods, driving boxes, shoes, wedges, and springs is the same as on the Porter steam dinkey.



Showing the Spring Suspension.



Power Plant, Clutch and Transmission.



New Porter Locomotive.

G. E. Suggestion Awards

The General Electric Company awarded $51,567 to 4,913 of its employes during 1927 for suggestions tending to improve working conditions or increase the efficiency of the company's operations. During the year 15,059 suggestions were offered, an increase of 500 over the previous year, and more than 32 per cent were accepted.

Hercules Fire Small Loss

On March 7th a frame auxiliary building adjoining the Hercules Motors Corporation in Canton, Ohio, was destroyed by fire. The loss was minor, and operations in the main building, which is of modern fireproof construction, have not been interrupted nor has production been retarded. The many users of Hercules Engines and personal friends of the Hercules organization will be pleased to know that there was no serious loss.

D. O. James Appoints

The D. O. James Manufacturing Company, Chicago, makers of all types of speed reducers and cut gearing, announce the addition to their Sales Department of Mr. R. C. Bird, in the capacity of Traveling Sales Manager.

New Carbic Sales Agents

The Carbic acetylene floodlight, the Carbic acetylene generator, as well as other Carbic equipment utilizing acetylene, formerly sold by the Carbic Manufacturing Company, Duluth, Minn., will in the future be distributed exclusively by the Oxweld Acetylene Company, 30 East 42nd Street, New York.

The processed carbide in cake form, sold under the trade-mark Carbi, for Carbic lights and generators, will be distributed exclusively by the Union Carbide Sales Company, New York, through its nationwide chain of warehouses.

Worthington Moves Offices

The executive offices of the Worthington Pump & Machinery Corporation, also its export sales department and New York district sales department, are being moved to No. 2 Park avenue, New York City, on or about April 1st.

As a part of a program to improve the efficiency of its service, Worthington has moved its head office sales and advertising departments to the Harrison plant of the Corporation, located at 421 Worthington avenue, Harrison, N. J.

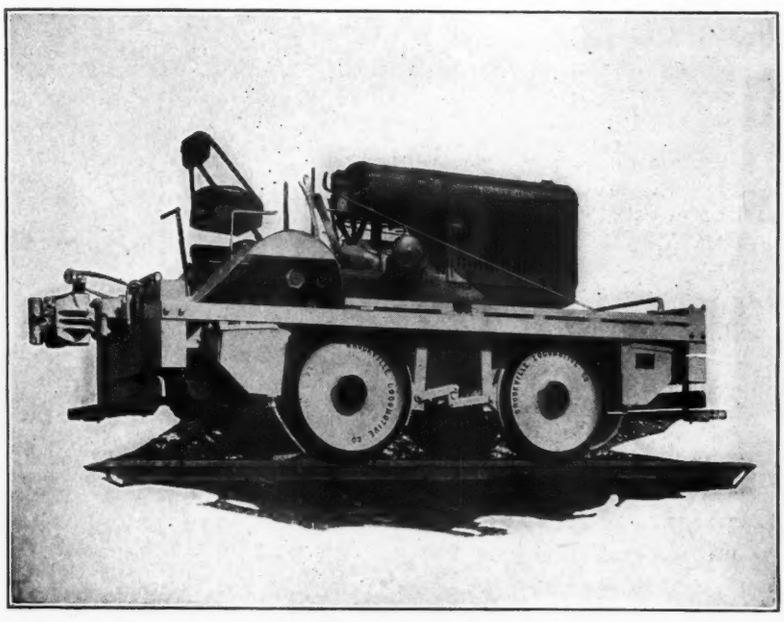
New Induction Motors

The Allis Chalmers Manufacturing Company is distributing its bulletin 1143, Line Start Induction Motors, type ARX. This design is said to retain all the superior features of Allis Chalmers induction motors, with the added characteristic for starting on full line voltage and holding the starting current within the limits recommended by the National Electric Light Association. The ARX motors are made in 2 or 3 phase, 60 cycle and in horse power ranging from 7½ to 30.

Brookville Locomotives Described

The Brookville Locomotive Company is distributing its illustrated Bulletin B-11, describing the Brookville 5, 6, 8, 10 and 12 ton locomotives, with three forward and three reverse speeds. It contains considerable data as to the duties performed by the locomotives and power required.

The bulletin especially features the 8 ton model IBW 15/30 industrial power unit shown in the illustration. It is equipped with a heavy ship channel frame; end sills and bumpers are heavy castings; four inch round steel driving axles; cast steel journal boxes with bronze bearings; dual system of brakes including cast iron on all four drivers with a McCormick-Deering emergency; the drive is positive on all four drivers with McCormick-Deering axles merely used to transmit power to lower shafts; either 24 or 36 wheels of 4 inch diameter and chilled face with 1⅛ inch flange; and a drawbar pull of 3,200 pounds are some of the features of this more recent development.



A Brookville 8-Ton Locomotive.

New Loader and Shovel

The announcement that the Lessmann Loader Company has developed an improved high-lift loader and also an improved low-lift shovel should be of interest to construction companies, contractors, public works officials and manufacturers.

The company has recently been completely re-organized, and with the introduction of the new capital some of the best engineering talent has been brought into consultation in improving the loader and shovel. The results have been some important changes in the construction and materials used in both machines, so that the Lessmann Loader and shovel are now as fool-proof as such equipment can be made.

Among the improvements is the substitution of steel for malleable iron in many of the parts, an improved clutch, cable tighteners which insure even hoisting of the bucket, anti-friction bearings, and an extra-long pinion shaft bushing of highest grade bronze. The mechanical principle of the loader, which has proved its efficiency has been retained in the new loader and shovel.

With the Lessmann the strain of lifting does not all come at the front of the tractor, but is at the center of the tractor. This feature not only means less strain on the equipment, but also insures greater efficiency and better balance, and greatly reduces the tendency of the tractor to rock or pitch forward when the bucket is loaded.

New Type Radiator

A new type radiator for Diesel and heavy duty engines has just been announced by the Perfex Corporation. The new feature is the mounting of an unusually large air circulating fan directly on the radiator frame. This is completely protected by a screen as shown and shrouded to insure uniform air circulation over the entire radiator. The fan is carried on anti-friction bearings and provided with a large enough belt pulley to insure positive fan operation over long periods without attention. On account of the large size of both radiator and fan it is usually very difficult to mount the fan on a diesel engine and at the same time locate it where the radiator may be efficiently cooled.

These radiators also incorporate the latest developments in removable core sections. Each unit is securely held in place by four nuts. This permits removal and repair of any individual section without dismantling the radiator and also continued operation of the power plant for reasonable periods while a section is out. An alternative is to carry a reserve section which can be put in the place of a damaged section in a few minutes.

The cores of these heavy duty radiators are made from copper to prevent corrosion. The tubes are oval in shape, have double lock seams that make them burst proof when frozen. Copper, heat radiating fins, strengthened by hemmed front and rear edges, furnish a most efficient design of cooling unit. These are baked onto the tubes in ovens that have automatic temperature control in order to insure uniformity of product. To supply the industrial field, a full line of these radiators are now available for prompt delivery in sizes from 50 to 350 horsepower.

Polyphase Induction Motors

The Allis Chalmers Manufacturing Company is distributing its new 16 page, illustrated bulletin 1118-E describing "Polyphase Induction Motors," types AR and ARY. In order to take advantage of improvements and advances made during recent years along various lines and benefit so far as is possible by the experience gained over an extended period under all conditions of operation, the lines of type AR squirrel cage motors and type ARY, slip ring motors have been developed. These types range in output from ¾ to 200 h.p. and are said to be a new development throughout. Some of the features of the AR and ARY motors are, extra heavy studs with special threaded ends, support laminations securely, add rigidity and make frame self supporting; cone pointed hexagon nuts, prevent shifting or looseness of laminated core; Timken roller bearings; form wound coils are sealed; rotor fans, bolted through end rings to rotor end plates; shaft of high carbon steel; frame of electric steel casting; notched tooth support, made of boiler plate; spider made of cast steel; and all air openings are so located as to minimize the entrance of foreign material.

Foote Note

Bentley and Holmgren, Room 406 Court Exchange Bldg., Bridgeport, Conn., have just been appointed to represent Foote Bros. Gear & Machine Company.

Rates for display advertisements in the Broadcast Section are given below. If you want to buy or sell used equipment, if you want a job or need a man, advertise your wants in Pit and Quarry. Advertisement copy for publication in the next issue should reach our office within one week after the date of this issue.

RATES PER INSERTION	1 Inch	2 Inches	3 Inches	4 Inches	5 Inches	6 Inches	8 Inches	9 Inches	10 Inches	12 Inches	15 Inches	20 Inches	30 Inches
1 Insertion	$3.75	$7.25	$10.75	$14.25	$17.75	$21.25	$28.25	$31.75	$35.25	$42.25	$56.25	$70.25	$105.00
2 Insertions	3.75	7.25	10.70	14.20	17.65	21.15	28.15	31.65	35.15	42.15	56.15	70.00	104.00
3 Insertions	3.75	7.20	10.65	14.15	17.55	21.05	28.05	31.55	35.10	42.05	56.05	69.75	103.00
4 Insertions	3.70	7.15	10.60	14.10	17.45	20.95	27.95	31.45	35.00	41.95	55.90	68.75	102.00
8 Insertions	3.65	7.05	10.50	14.00	17.25	20.75	27.75	31.25	34.80	41.75	55.70	67.50	98.00
13 Insertions	3.60	6.95	10.40	13.90	17.05	20.55	27.55	31.05	34.60	41.55	55.55	66.25	94.00
26 Insertions	3.50	6.75	10.20	13.70	16.65	20.05	27.05	30.65	34.20	41.05	55.05	64.00	88.00

INFORMATION—*"Broadcast"* space is sold by the advertising "inch." Each page contains 30 inches. The width of the page is divided into 3 columns, each 2¼ inches wide. Each column contains 10 inches measured the length of the column. Any space may be used measured by the *even* inch in height (not fractions), by 1, 2 or 3 columns in width. The size of a space is its height in inches multiplied by the number of columns in width. Example: a space 3 inches high by 2 columns wide is 6 inches. Copy changes made without additional charge.

It Pays to Advertise in PIT and QUARRY

The Illinois Valley Silica Co., Ottawa, Ill., recently advertised for a plant superintendent. Writing in regard to the results received they state: *"We received enough replies to make a satisfactory selection."*

Complete Service Publishing Company

538 South Clark Street **CHICAGO**

Machinery for Sale

SPECIALS
1—New 8'x125' Allis-Chalmers Rotary Kiln

CRUSHERS

Crushing Rolls

1—8"x5", 1—16"x10", 4—24"x12", 1—26"x15", 1—30"x10", 1—30"x16", 2—36"x16", 1—42"x16" (New), 1—54"x24".

Gyratory

All sizes from No. 2 Reduction to No. 12K.

Jaw

One 4"x8"—two 7"x10"—one 6"x20"—two 9"x15"—one 10"x20"—two 12"x24"—one 18"x36"—one 24"x36"—one 42"x30" Farrell—one 42"x36" Farrell—one 60"x84".

Rotary

Two No. 0, two No. 1, one No. 1½, and one No. 2 Sturtevant Rotary Fine Crushers.

Ring Roll

One No. 1 and one No. 2 Duplex Sturtevant ring roll mills.

Ball and Tube Mills

3', 4', 4½', 5', 5½', 6', 8' Hardinge Mills and Tube Mills.

DRYERS

One 3'x30', Three 4'x30', One 4½'x30', One 5'x40', One 5½'x40', One 6'x60', One 7'x60' and One 8'x80' Direct Heat Rotary Dryers, One 5'x25', one 6'x30', Two 8'x80' Ruggles Coles type "A" and One 4'x20' Ruggles Coles type "B" Double Shell Rotary Dryers.

KILNS

4'x40', 5'x60', 6'x60', 6'x70, 6'x90', 6'x100', 6'x120', 7'x80', 8'x125'.

MILLS

Two 33" and two 42" Fuller Lehigh Mills.
One No. 0000, and two No. 1, one 2-roll, and two 4-roll Raymond.
Swing Hammer Mills, Griffin Mills, Attrition and Cage Mills.
Air separators, Screens, Elevators and Conveyors.

The Heineken Engineering Corp.
Industrial Engineers
95 Liberty St., New York City
Hanover 2450

LOCOMOTIVES

1—56-ton 6-wheel Standard gauge Saddle Tank, new A.S.M.E. boiler, electric head lights, oil burning equipment.

LOCOMOTIVE CRANES

1—30-ton Ohio 8 wheel, double power drums, 50-ft. boom outriggers, factory rebuilt.
1—22½-ton Ohio 8 wheel, double power drums, 50-ft. boom, factory rebuilt.

CATERPILLAR SHOVELS

1—68C Bucyrus electrically operated shovel on caterpillars.
1—20B Bucyrus Steam Shovel on caterpillars.

Morris Engineering Co.
Phone: Cortland 0604
30 Church St., New York

CRAWLER SHOVELS

2—ERIE B-2 DREADNAUGHT, Steam Caterpillar, New 1926, 1-Yd. Dippers, HIGH LIFT; Overhauled, Like New.

1—50-B BUCYRUS, Steam Caterpillar; New 1927; 1¾-Yd. Dipper; Used few months; Perfect Condition.

1—OSGOOD HEAVY DUTY (1-Yd.) GASOLINE Caterpillar, 1-Yd. Dipper, HIGH LIFT, Excellent condition.

CRANES

1—NORTHWEST, Model No. 105, Gasoline Caterpillar Crane, New 1926, 40 ft. Boom, Bucket operating, Overhauled, Excellent condition.

2—25-ton, 8-wheel, INDUSTRIAL, Type G, Locomotive Crane, New 1927, 50 ft. booms.

DUMP CARS

25—5-yard, 36 in. gauge WESTERN, two-way side Dump, new 1927; STEEL DRAFT BEAMS; used few months, perfect condition.

GREY STEEL PRODUCTS CO.
111 Broadway New York, N. Y.

PULVERIZER

Raymond Impact Pulverizer No. 1, complete with cyclone tubular collectors, piping, fan, belts and quantity new spare parts.

CRANE ATTACHMENTS

1—Osgood 40 ft. clam shell or drag line boom with new holding drum for clam shell or drag line with ¾ yd. type C drag line bucket.

ELECTRIC HOIST & DERRICK

1—75 H.P. 3 drum Hoist with Swinger and 70 ft. Boom, Steel Guy Derrick.

CRUSHER

1—30x36 Jaw Crusher, new manganese fittings, new bearings, with quantity extra parts.

A. J. O'NEILL CO.
406 Weightman Bldg., Philadelphia, Pa.

FOR SALE OR RENT

DUMP CARS

5—12-yd. Western, Std. Ga., Air. Perfect Condition.

GASOLINE SHOVELS AND CRANES

1—Link-Belt Comb. Gas-Crawler, 1-yd. Shovel and 15-ton, 50 foot boom Crane. Like new.
1—Northwest, Model 105, 50' Boom. 2-yrs-old.

STEAM SHOVELS

1—McMyler ¾-yd. Cat. Steam; also 40' Crane Boom. New 1927.
1—Marion, Model 32, 1¼-yd. Dipper, Full Cat., High Lift, Rebuilt 1927. Perfect shape.

GASOLINE LOCOMOTIVES

2—7-ton Plymouth, 36" Gauge. Like new.
1—8-ton Plymouth, 36" Gauge. Like new.

HOISTING ENGINES

1—40 HP. Mundy, DD, 2-ph., 60-cyc., 220-v.
1—22 HP. Lambert, DD, 2-ph., 60-cyc. 220-v.
1—7x10 Lidgerwood, DC, DD, Boiler mounted with Swinger attached

BOILERS

1—125 HP. Locomotive Type, ASME, 125 lb. Pressure.

TRACTORS

1—10-ton Holt, Gas. Cat.
1— 2-ton Holt, Gas. Cat.
1— 5-ton Holt, Gas. Cat.

B. M. WEISS
1324 Widener Bldg., Philadelphia, Pa.